UI Bulletin #80c

Subject: Power Take Off (PTO) Subsystem Operating Description and Application Guide

Models Affected: C/K 3500 Series Heavy Duty Chassis Cab, Chevrolet Silverado and GMC Sierra. Models C/K 31003, 31053 & 31403

Model Years: 2008 - 2014

Date: February 27, 2007

Revision Date: September 15, 2014

ADVISORY:

FOR THE 2015 AND NEWER MODEL YEAR VEHICLES REFER TO UI BULLETIN #120

This bulletin provides a complete description of the PTO option on the all new Heavy Duty Chassis Cab Chevrolet Silverado and GMC Sierra. The PTO subsystem option includes all of the components & wiring for a tested, functional system as ordered from the factory.

This Bulletin (Bulletin 80) is the complete Operating Description and Application Guide. Bulletin 79 is an overview.

TABLE OF CONTENTS

1. Overview
2. PTO Components
3. PTO Operation
4. Driver Warnings
5. Engine Speed Control Modes
6. Remote Engine Start And Shutdown Control
7. Reprogramming PTO
8. PTO Electrical Wiring Connections
9. Appendix A: Upfitter Mating Connector
10. Appendix B: PTO Applications
11. Appendix C: PTO Module Harness Connector
12. Appendix D: Service Diagnostics

Notes: This bulletin addresses the “All New” not the “Classic” C/K Truck. The PTO option can’t be added or retrofitted if not included as ordered.

Disclaimer: GM Upfitter Integration Technical Bulletins are intended for use by professional technicians, NOT a "do-it-yourselfer". They are written to inform these technicians of conditions that may occur on some vehicles, or to provide information that could assist in the proper service and/or modification of a vehicle. These properly trained technicians have the equipment, tools, safety instructions, and know-how to do a job properly and safely. If a condition is described, DO NOT assume that the bulletin applies to your vehicle, or that your vehicle will have that condition. Contact GM Upfitter Integration for information on whether the information is applicable your vehicle.

TABLE OF CONTENTS

1. OVERVIEW 4

1.1. NEW FEATURES FOR MODEL YEAR 2007 4
2. PTO COMPONENTS 5
2.1. FACTORY INSTALLED PTO COMPONENTS 5
2.1.1. PTO IN-CAB SWITCH 6
2.1.2. PTO GEAR 6
2.1.3. PTO MODULE 6
2.1.4. PTO UPFITTER CONNECTOR 6
2.2. AFTERMARKET UPFITTER/BODY BUILDER ADD-ON COMPONENTS 6
2.2.1. PTO RELAY 6
2.2.2. REMOTE PTO ENABLE SWITCH 6
2.2.3. REMOTE ENGINE START SWITCH 7
2.2.4. REMOTE ARMING SWITCH 7
2.2.5. REMOTE ENGINE SHUTDOWN SWITCH 7
2.2.6. REMOTE PTO SET SWITCH 7
2.2.7. REMOTE PTO ACCELERATOR SENSOR 7

3. PTO OPERATION 7

3.1. PTO ENABLING CONDITIONS 7
3.1.1. STATIONARY PTO ENABLING CONDITIONS 7
3.1.2. MOBILE PTO ENABLING CONDITIONS 8
3.2. PTO DISENGAGE CONDITIONS 8
3.2.1. STATIONARY PTO ADDITIONAL DISENGAGE CONDITIONS 8
3.2.2. MOBILE PTO ADDITIONAL DISENGAGE CONDITIONS 9

4. DRIVER WARNINGS 9

4.1. DRIVER INFORMATION CENTER (DIC) WARNING MESSAGES 9
4.2. PROLONGED OR EXTENDED PTO OPERATION 10

5. ENGINE SPEED CONTROL MODES 10

5.1. PRESET PTO MODE 10
5.1.1. IN-CAB PTO SET SWITCH OPERATION 10
5.1.2. REMOTE PTO SET SWITCH OPERATION 11
5.1.2.1. MOMENTARY SET SWITCH OPERATION 11
5.1.2.2. LATCHING SET SWITCH OPERATION 11
5.2. VARIABLE PTO MODE 13
5.2.1. IN-CAB PTO SWITCH OPERATION 15
5.2.2. REMOTE PTO SWITCH OPERATION 15

TABLE OF CONTENTS (cont'd)

6. REMOTE ENGINE START AND SHUTDOWN CONTROL 16
6.1. REMOTE ENGINE SHUTDOWN 16
6.2. REMOTE ENGINE START 16
7. REPROGRAMMING PTO 17
7.1. PTO CONFIGURATION MODE SETTING 17
7.2. PTO FACTORY DEFAULT SETTINGS 18
8. PTO ELECTRICAL WIRING CONNECTIONS 20
8.1. REMOTE ENGINE START SWITCH CIRCUIT 20
8.2. REMOTE ENGINE SHUTDOWN SWITCH CIRCUIT 20
8.3. REMOTE PTO ARMING AND ENABLE ("ON"/"OFF") SWITCH CIRCUITS 21
8.4. REMOTE PTO SET SPEED SWITCH CIRCUIT 21
8.5. REMOTE ACCELERATOR CIRCUIT 22
8.6. PTO LOAD RELAY AND LOAD FEEDBACK CIRCUITS 23
8.7. REMOTE PTO INDICATOR CIRCUIT (MY2009) 24
8.8. REMOTE TACHOMETER CIRCUIT (MY2009) 24
9. APPENDIX A: UPFITTER MATING CONNECTOR 25
9.1. CONNECTOR COMPONENTS 25
9.2. CONNECTOR PIN FUNCTIONS 26
10. APPENDIX B: PTO APPLICATIONS 27
10.1. STATIONARY PTO - FULL FUNCTION SYSTEM 29
10.2. TOW TRUCK / VEHICLE HAULER 31
10.3. LIFT BUCKET / LIFT GATE 33
10.4. WATER PUMPING OPERATION / ELECTRIC GENERATOR / LIFT GATE 35
10.5. AIR COMPRESSOR / A/C COMPRESSOR 37
10.6. SNOW PLOW / SALT SPREADER / FERTILIZER SPREADER / ROAD GRADER / STREET SWEEPER / DUMP BOX 39
11. APPENDIX C: PTO MODULE HARNESS CONNECTOR 41
12. APPENDIX D: SERVICE DIAGNOSTICS 44
12.1. DIAGNOSTIC TROUBLE CODES 44

1. Overview

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source, for running add-on equipment, such as, salt spreaders, snow plows, winches, lift buckets, etc. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting (and shutdown) of the engine.

PTO is available on the GM Full-size Trucks:

- 3500 Heavy Duty Cab-chassis (Sierra and Silverado)
- Standard and Extended Cab models (PTO is not offered with crew cab)
- Engine: 6.6L Duramax (RPO=LMM), ONLY.
- Transmission: Allison LCT-1000 (RPO=MW7)

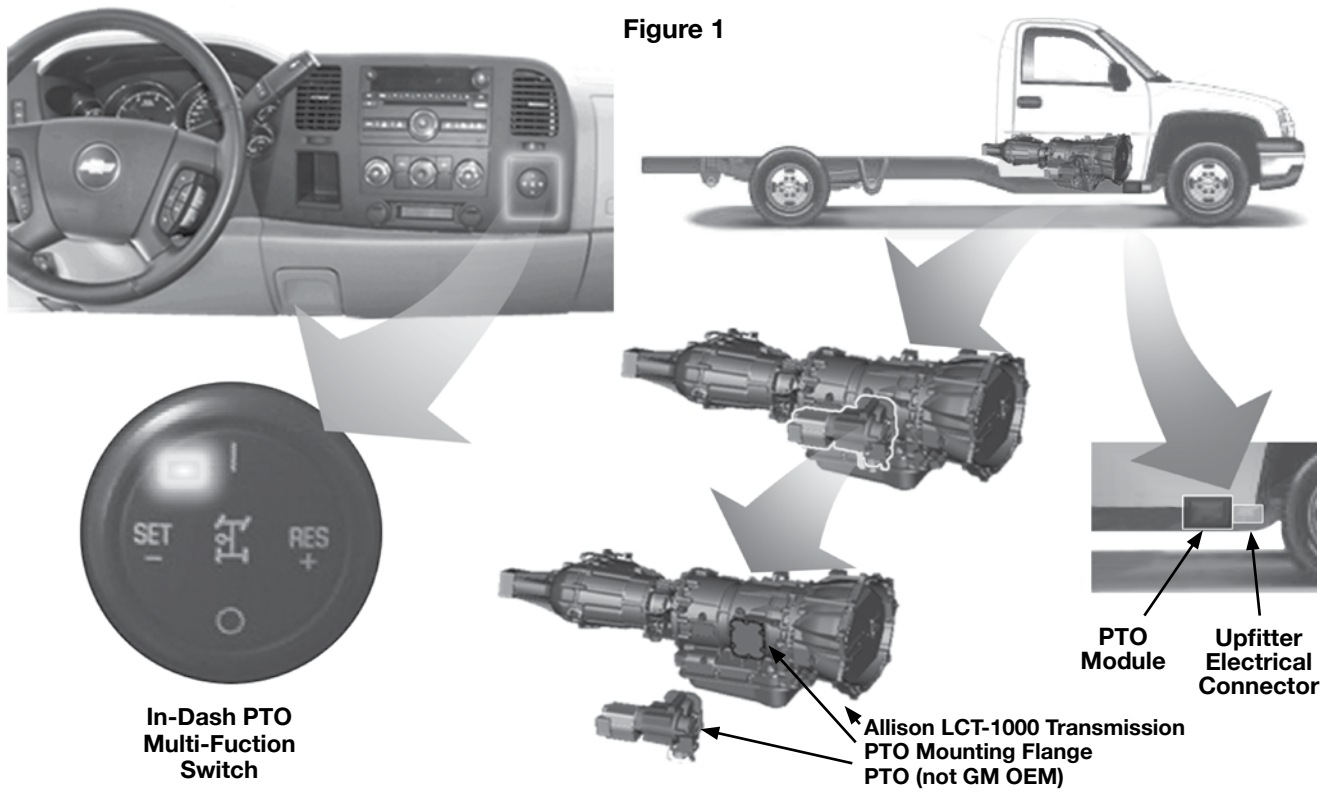
NOTE: For MY2007 and beyond, PTO after-market conversion kits are NOT offered on full size trucks. PTO cannot be retrofitted on a vehicle that is not ordered with PTO (RPO=PTO).

1.1. New Features for Model Year 2007

- Vehicle comes pre-wired for PTO, when PTO option (RPO=PTO) is ordered. No After-market PTO kit is required.
- New dedicated PTO in-cab switch. Cruise control no longer required for full function PTO.
- Dedicated PTO upfitter connector.
- Improved PTO documentation (Owners/Service/Body Builders Manuals).
- New dedicated PTO Module provides more capability and configurability:
  - o Remote Enable Switch provides independent remote enable/disable of PTO.
  - o Remote Engine Start/Shutdown provided as a feature with the PTO option (programmable “ON” or “OFF”)
  - o Automatic engine shutdown / horn chirp warning for critical engine conditions: Low Oil Level, Low Oil Pressure, Hot Engine Coolant, Hot Transmission Fluid, Low Fuel Level and Diesel Particulate Filter Regeneration.
  - o Adjustable RPM Tap-up/Tap down increments (4 to 500 RPM).
  - o Adjustable RPM ramp rate control (4 to 500 RPM/sec) for slow and fast engine speed transitions.
  - o Latching PTO switch allows easier interface for air compressor and AC refrigeration vehicles.
  - o In-Cab and remote PTO switch lock-out to improve operational safety.
  - o Unique PTO transmission shift patterns to reduce transmission shift business in mobile PTO operation.
  - o Improved Tech II service tool diagnostics to aid dealership and upfitter in PTO system trouble shooting and set-up.
  - o Remote vehicle speed output (4000 pulses per mile).
  - o For model year 2009, remote tachometer output and remote PTO LED will also be available.

2. PTO Components

Figure 1



2.1. Factory Installed PTO Components

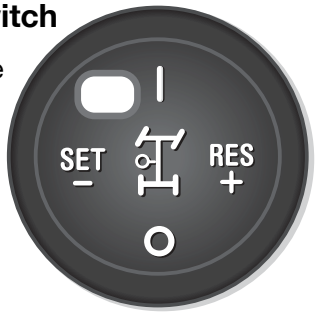
The following PTO components (see Figure 1) are installed as part of the factory installed content of the vehicle:

- Transmission driven PTO Gear
- Dash Mount PTO Switch
- PTO Module (PTOM)
- PTO Specific Upfitter Connector
- Driver Information Center (DIC)
- Revised underbody structure and floor covering

NOTE: For MY2007 and beyond, PTO after market conversion kits are NOT offered on full size trucks. PTO cannot be retrofitted on a vehicle that is not ordered with PTO (RPO=PTO).

2.1.1. PTO In-cab Switch

The PTO switch (see Figure 1) is mounted in the right side of the center instrument panel as part of the factory installed PTO package. The PTO switch is a four position rocker type:



When the PTO I position is pushed, the PTO relay will be energized by the PTOM. A PTO LED indicator is integrated with the switch. The indicator will turn on blinking at a fast rate (¼-second interval) when the PTO relay is energized. The indicator turns on solid once the PTO load feedback signal confirms the load has been engaged or after 3 seconds if load feedback is not utilized by the PTO system. The indicator will blink slowly (1 second interval) when PTO memory speed is retained.

Pushing the O switch position turns "OFF" PTO. The PTO LED will turn off once engine speed reaches base engine idle, at which time the PTO relay is de-energized.

The PTO In-cab switch has the redundant interlocks built into the switch circuit contacts. The switch provides three Mode signals (A, B and C) which are encoded by the PTO module to determine the

I , O , SET − and RES +

states of the switch. These three mode signals are encoded in such a way to provide redundant checking of any switch actuations.

Illumination of the switch background text is provided through the dimming circuit controlled by the BCM.

(continued on Page 6)

2. PTO Components (cont'd)

2.1.2. PTO Gear

The Allison LCT-1000 transmission provides the PTO gear installed with the PTO option package. If the vehicle is not ordered with the PTO option, then the PTO gear will not be included in the transmission.

2.1.3. PTO Module

The PTO electrical system is integrated around a central PTO module (PTOM). The PTOM provides the following key functions:

- Processes the PTO operator switch inputs and translates these inputs into an engine speed request to the engine control module (ECM).
- Controls the engagement of the PTO load relay.
- Process requests to the BCM and ECM to start and shutdown the engine.
  See sections 6.1. and 6.2.
- Requests the Engine Control Module (ECM) to command an engine shutdown and engine shut down horn warning for critical engine and transition conditions (stationary remote PTO, only).
  See section 6.1.
- Requests the Instrument Panel Cluster (IPC) to display on the Driver Information Center (DIC) actions the driver must take to enable PTO.
  See section 4.1.

The PTO system also utilizes the following vehicle electronic modules, which communicate over the vehicle's serial data system:

- The body control module (BCM):
  - ➢ Maintains the PTO configuration mode (PTO's factory default mode).
  - ➢ Serves as the vehicle remote engine start master controller.
- The engine control module (ECM)
  - ➢ Controls engine speed based on requests from the PTOM
  - ➢ Controls engine starting based on requests from the PTOM
  - ➢ Provides PTO specific engine information to the PTOM.
- The instrument panel cluster (IPC)
  - ➢ The DIC of the IPC displays actions the driver must take to turn "ON" PTO.
- The transmission control module (TCM)
  - ➢ Adjust shift patterns to minimize shift busyness during PTO operation.
  - ➢ Provide transmission gear state and temperature conditions to the PTOM.

2.1.4. PTO Upfitter Connector

(See Appendix A-Pg. 25)

The PTO upfitter connector provides access to all remote PTO functions. The connector is located on the right-hand outside frame rail, underneath the passenger side door (see Figure 1). Electrical connections to the following components are provided by this connector. The upfitter connector pin circuits (other than battery, ignition and ground) are disabled as the vehicle is received from the factory. The PTO module must be re-programmed by the upfitter or dealer to specially enable these circuit functions.

- Remote PTO Arming
- Remote PTO Enable
- Remote PTO Set
- Remote Accelerator
- Remote Engine Start
- Remote Engine Shutdown
- PTO Load Relay Control
- PTO Load Feedback
- PTO Remote Indicator
  (available starting with model year 2009 vehicles)
- Remote Tachometer
  (available starting with model year 2009 vehicles)

2.2. Aftermarket Upfitter/Body Builder Add-on Components

The following PTO system components (if required) must be provided by and installed by the aftermarket upfitter or body builder. These functions are disabled when the vehicle is received from the factory and must be enabled by the service technician. See section 7 Programming PTO.

2.2.1. PTO Relay

The PTO relay must be provided by the vehicle upfitter (if relay is desired). The PTO Module controls both the high side (power side) and low side (ground side) of the PTO relay. If the PTO relay is used to engage the PTO load, the upfitter must use both these signals, or the PTO module will prevent PTO operation. Note: PTO relay control must be programmed "ON" by the service technician.

2.2.2. Remote PTO Enable Switch

The remote enable switch is a Single-Pole, Single-Throw (SPST), latching type switch installed by the vehicle upfitter. The switch is used to turn "ON" or "OFF" PTO remotely for applications where the operator is not in the vehicle. The remote PTO enable switch must be used in conjunction with the PTO Arming switch to enable remote PTO. See PTO Interlocks. NOTE: On vehicle programs

(continued on Page 7)

2. PTO Components (cont'd)

prior to model years 2007 (GMT800), the load engage switch was used to supply voltage from the PTO relay switch contacts. When the switch is closed current will flow to the PTO solenoid. This function has been replaced by the "Remote PTO Enable" Switch. GM discourages upfitters from using a load engage switch because it will interfere with PTO module diagnostics intended to protect the operator.

Remote PTO enable switch requires an arming sequence prior to enabling PTO. To initiate remote PTO operation the operator must first press and release the "Remote Arming" switch, then within 5 seconds push the "Remote PTO Enable" switch to turn "ON" PTO. The PTO system will then enter standby mode. The PTO relay is energized and the engine RPM is increased to 850 RPM (Factor preset value).

2.2.3. Remote Engine Start Switch

The remote engine start switch is a normally-open (N.O.), momentary type switch installed by the vehicle upfitter. The switch is used to start the engine from a remote location outside the vehicle cab. PTO does not need to be selected for this switch to operate. The remote starting switch must be used in conjunction with the Remote Arming switch to remotely start the engine. When remotely starting the vehicle, press and release the "Remote PTO Arming" switch, then within 5 seconds push the "Remote Start" Switch.

2.2.4. Remote Arming Switch

The remote arming switch is a normally-open (N.O.), momentary type switch installed by the vehicle upfitter. The switch is used in conjunction with the remote PTO enable and remote engine start switch. To initiate remote PTO operation the operator must first press and release the "Remote PTO Arming" switch, then with in 5 seconds push the "Remote PTO Enable" switch to turn "ON" PTO. If remotely starting the vehicle, press and release the "Remote PTO Arming" switch, then within 5 seconds push the "Remote Start" Switch.

2.2.5. Remote Engine Shutdown Switch

The remote engine shutdown switch is a normally-closed (N.C.), momentary type switch installed by the vehicle upfitter. The PTO remote engine shutdown switch (or engine "KILL" switch) provides the operator a method for routine or for emergency shutdown the engine. PTO does not need to be operating for this switch to function.

2.2.6. Remote PTO Set Switch

The remote PTO set switch input to the PTO module can be programmed to function as a Single-Pole, Double-Throw (SPDT) momentary or latching type switch installed by the vehicle upfitter. The switch is used to set the engine speed from a remote location outside the vehicle cab. The switch will not operate unless PTO is initially enabled.

2.2.7. Remote PTO Accelerator Sensor

The remote PTO accelerator sensor is installed by the vehicle upfitter. The sensor is used to adjust the engine speed from a remote location outside the vehicle cab. The sensor will not operate unless PTO is initially enabled. The in-cab PTO switch SET-/RES+ and remote set switch will not function when the remote accelerator sensor is used.

3. PTO Operation

The PTO Module (PTOM) is the control center of the PTO system. The PTOM monitors numerous engine and vehicle conditions which must be satisfied before PTO can be enabled.

3.1. PTO Enabling Conditions

3.1.1. Stationary PTO Enabling Conditions

To engage stationary PTO operation, the following conditions must be met:

- The engine must be running.
- The vehicle cannot be moving and the parking brake must be set.
- The shift lever must be in PARK (P) or NEUTRAL (N).
- The brake pedal must not be pressed.
- The engine speed must be less than the maximum allowed PTO engage speed of 1500 rpm. The PTO engage speed can be adjusted by a service technician.

For in-cab PTO operation:

Press and release the

position on the PTO switch. The PTO LED light will blink fast until the PTO load becomes engaged. The LED light will then be on steady.

The

and

switch positions can then be used to establish the desired PTO operating speed.

(continued on Page 8)

3. PTO Operation

For remote PTO operation:

Press and release the remote PTO arming switch, then within five seconds, move the PTO enable switch from “OFF” to “ON” (open to closed). The remote LED light will come on when the PTO Load is engaged. The PTO remote SET switch can then be used to establish the desired PTO operating speed. Additional information is available in the service manual for the correct wiring configuration and programming of the remote PTO enable and set switches. These switches are accessed through the PTO upfitter connector, located on the frame rail under the passenger side door.

3.1.2. Mobile PTO Enabling Conditions

To engage mobile PTO operation, the following conditions must be met prior to turning on PTO:

- The engine must be running.
- The vehicle speed must be less than the PTO top vehicle speed limit. The default setting is 50 mph (80 km/h). This limit can be adjusted by a service technician.
- The shift lever may be in any position.
- The brake must be pressed and then released. The brake must then remain released.
- Cruise control cannot be active.
- Engine speed must be less than the maximum allowed PTO engage speed of 1500 rpm.
- Press and release the position on the PTO switch. The PTO LED light will blink fast until the PTO load becomes engaged, at which point the LED light will be on steady. The -/SET and +/RES switch positions can then be used to establish the desired PTO operating speed. See Variable PTO Mode - PTO Switch operation below.

3.2. PTO Disengage Conditions

To disengage the stationary or mobile PTO operation, do one of the following:

- Press the brake. PTO will disengage immediately. The PTO LED will blink slowly, indicating that the PTO set speed is stored in memory. Pressing the switch position will restore engine speed to the stored PTO set speed.

  Note: In mobile PTO mode, PTO can be reprogrammed to re-engage at PTO standby speed after releasing the brake pedal.
- Press the on the PTO in-cab switch. The engine speed will decrease to base engine idle, then the PTO LED light will turn “OFF”, and the PTO load relay will disengage.
- From the remote PTO controls, move the remote enable switch to the “OFF” position. The engine will return to normal idle. The PTO load relay is disengaged. PTO memory speed is also cleared. (Stationary PTO only)
- From the remote PTO controls, press the remote engine shutdown switch. PTO is disengaged and the engine is shutdown simultaneously. (Stationary remote PTO only)

3.2.1. Stationary PTO Additional Disengage Conditions

The stationary PTO mode will also disengage if any of the following conditions are detected by the vehicle electronics:

- Movement of the vehicle.
- The park brake is released.
- The transmission is shifted from PARK (P) or NEUTRAL (N) to DRIVE (D) or REVERSE (R).
- The PTO load becomes disengaged (this condition is indicated by the PTO load feedback changing from a high voltage {approx 12 Volts} to a low voltage {approx 0 Volts} while PTO is engaged).
- Engine speed exceeds the maximum allowed PTO operating speed of 3100 rpm (factory setting = 2100 rpm), or
- Engine speed is 200 rpm greater than the operator-requested speed for 6 seconds, or
- The PTO control system will attempt to limit accelerator pedal and PTO switch input as the vehicle approaches the above operational limits. There are some vehicle conditions, such as downhill acceleration, which may cause vehicle speed and/or engine speed limits to be exceeded. Under these conditions, the PTO is disengaged.

(continued on Page 9)

3. PTO Operation (cont'd)

3.2.2. Mobile PTO Additional Disengage Conditions

The mobile PTO mode will also disengage if the following conditions are detected by the vehicle electronics:

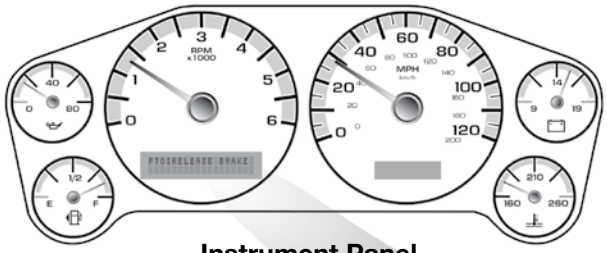
- Vehicle speed exceeds 50 mph (factory setting = 80 km/h).
- Engine speed exceeds the maximum allowed PTO operating speed of 3100 rpm (factory setting = 2100 rpm).
- The PTO control system will attempt to limit accelerator pedal and PTO switch input as the vehicle approaches the above operational limits. There are some vehicle conditions, such as down hill acceleration, which may cause vehicle speed and/or engine speed limits to be exceeded. Under these conditions, PTO is disengaged.
- The PTO load becomes disengaged (this condition is indicated by the PTO load feedback changing from a high-voltage state {approx 12 Volts} to a low-voltage state

4. Driver Warnings

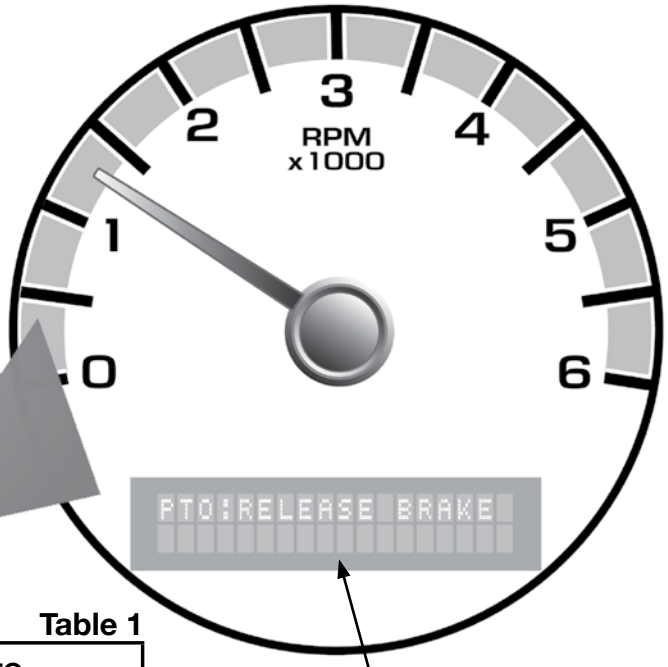
4.1. Driver Information Center (DIC) Warning Messages

If the PTO will not engage, one or more of the following DIC messages may appear on the instrument panel cluster (IPC). To successfully engage PTO, the operator must take the action indicated, then again press and release the position of the PTO switch.

In addition to these messages, the PTO switch LED will indicate when all conditions required to engage PTO have not been met. When enabling PTO, the LED will turn "ON", then "OFF" after one second. Under normal operating conditions, the PTO LED will remain "ON" throughout the PTO operating cycle.



Instrument Panel Cluster (I.P.C.)



Driver Information Center (D.I.C.)

DIC PTO Messages **Table 1**

Stationary PTO	Mobile PTO
MY2007 - PTO: RELEASE ACCELERATOR (MY2008 - PTO: REDUCED VEHICLE SPEED	PTO: DISENGAGE CRUISE CONTROL
PTO: RELEASE BRAKE	PTO: PRESS & RELEASE BRAKE
PTO: REDUCE ENGINE SPEED	PTO: REDUCE ENGINE SPEED
PTO: SHIFT TO P OR N	PTO: RELEASE BRAKE

* Note - Speed Range DIC message indicates a programming mismatch between the PTOM and the ECM. This occurs if modules are not sychronized during service programming.

(continued on Page 10)

4. Driver Warnings (cont'd)

4.2. Prolonged or Extended PTO Operations

While operating your vehicle in stationary PTO mode, the Diesel Particulate Filter (DPF) will continue to filter the exhaust and accumulate soot. The engine control system, depending on the speed and load being applied by the PTO, may not be able to generate enough energy or adequate heat needed to clean or regenerate the DPF.

Continued operation under conditions that do not allow effective regeneration or cleaning will eventually plug the DPF and result in reduced power. The ENGINE POWER IS REDUCED Driver Information Center (DIC) message and Malfunction Indicator Lamp will be displayed, and dealer/retailer service will be required to return your vehicle to normal, full power operation.

To prevent this from occurring, frequently monitor your vehicle during PTO operation, paying particular attention to the CLEAN EXHAUST FILTER SEE OWNER MANUAL NOW DIC warning message. If the DIC message is displayed during PTO operation, see Diesel Particulate Filter for information on how to

5. Engine Speed Control Modes

5.1. Preset PTO Mode

Preset PTO can only be used when the vehicle is not moving. After the PTO in-cab switch position is pressed and released, the engine speed is initially set to a stand-by engine speed (850 rpm). Using Remote switch controls, by pressing and releasing the remote arming switch, then within five seconds, push the remote PTO enable switch to "ON" will also establish standby speed operation. This provides an initial start-up engine speed to match the engagement of the PTO load. The PTO standby engine speed can be reprogrammed to a higher speed by your dealer.

Pressing the switch position on the PTO in-cab switch or moving the remote PTO enable switch to "OFF" will return the engine speed back to normal idle. The PTO load relay is also disengaged.

Maximum PTO Operating Speed: During PTO operation, the accelerator pedal can be pressed to adjust the engine speed. To protect the PTO from overspeed, the PTO system will disengage when the engine speed exceeds 2100 rpm for longer than 6 seconds.

The Stationary PTO Mode provides both in-cab and remote controls. The in-cab controls are enabled as the factory preset. The remote controls are disabled. This factory preset configuration can also be reprogrammed to enable the remote controls, and disable the In-Cab PTO controls (i.e., PTO switch, accelerator pedal). See your dealer for more information.

5.1.1. In-Cab PTO Set Switch Operation

Three factory pre-programmed engine speeds can be selected from the In-Cab PTO switch.

- **The first speed** is selected when the PTO system is turned "ON". This is the PTO Standby speed – 850 rpm.
- **The second engine speed** – 1250 rpm can now be selected by depressing the portion of the switch.
- **The third engine speed** – 1700 rpm can be selected by depressing the portion of the switch.

Each of these three speeds can be reprogrammed by a service technician to values other than the factory settings.

- **PTO ON**: Pressing the position of the PTO switch will cause the engine to go to the PTO preset Standby speed – 850 rpm.

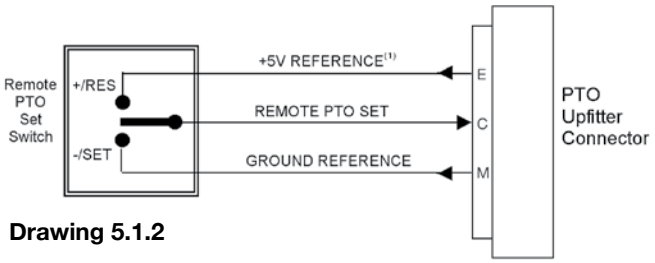
Note: Many applications just use "ON" and "OFF" for a single working speed. Since the PTO Standby speed is programmable, you can select the desired working speed and simply turn the system "ON" – to run at this speed and then turn it "OFF" again.

(continued on Page 11)

5. Engine Speed Control Modes (cont'd)

5.1.2. Remote PTO Set Switch Operation

In the Preset PTO Mode, the remote PTO set switch can be programmed to operate with a momentary switch type or a latching switch type.



Drawing 5.1.2

5.1.2.1. Momentary Set Switch operation

In the Preset PTO Mode, the momentary PTO set switch operates like the in-cab PTO switch. See section

5.1.2.1. Momentary Set Switch operation

Set Switch Voltage	RPM
Less than 1.66 V* **Typical nominal voltage should be 0 V*	SET SPEED_1 Factory preset = 1250 RPM
Greater than 1.66 V and less than 3.33 V* **Typical nominal voltage should be 2.5 V*	STANDBY SPEED Factory preset = 900 RPM
Greater than 3.33 V* **Typical nominal voltage should be 5 V*	SET SPEED_2 Factory preset = 1700 RPM

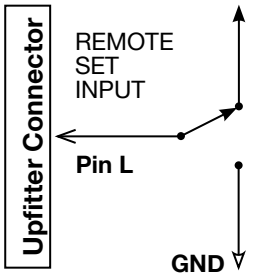
5.1.2.2. Latching Set Switch operation

The momentary PTO set switch can also be programmed to operate with a latch type switch. This programming option is intended to support air compressor or air conditioning type systems, which cycle off and on as a result of a pressure switch cycling.

Set Switch Voltage	Factory Default Setting	Programmable States
Remote Set Switch Transition to Low Voltage (less than 1.66 V*) **Typical nominal voltage should be 0 V*	SET SPEED_1	STANDBY SPEED, SET SPEED_1, SET SPEED_2
Remote Set Switch Transition to Open State (greater than 1.66 V and less than 3.33 V)* **Typical nominal voltage should be 2.5 V*	PTO_STANDBY	STANDBY SPEED, SET SPEED_1, SET SPEED_2
Remote Set Switch Transition to High Voltage (greater than 3.33 V)* **Typical nominal voltage should be 5 V*	SET SPEED_2	STANDBY SPEED, SET SPEED_1, SET SPEED_2

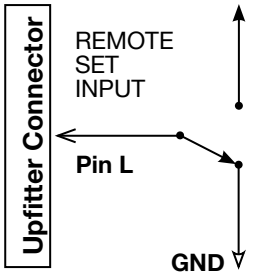
(continued on Page 12)

5. Engine Speed Control Modes (cont'd)



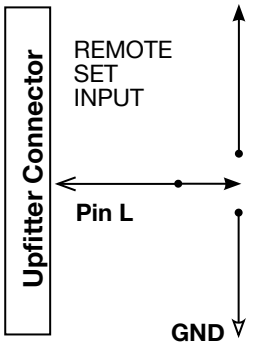
High Voltage programmed to be SET SPEED 2 (Factory Preset Values)
While the Set switch wire input voltage is greater than 3.5V, then engine speed will go to 1250 RPM (Factory preset value for SET SPEED_1)

Note: The Remote Set Input can be reprogrammed so that the High Voltage = STANDBY SPEED or SET SPEED 2



Low Voltage programmed to be SET SPEED 2 (Factory Preset Values)
While the Set switch wire input voltage is less than 1.3V (grounded), then engine speed will go to 1700 RPM (Factory preset value for SET SPEED_2)

Note: The Remote Set Input can be reprogrammed so that the Low Voltage = STANDBY SPEED or SET SPEED 1



Open Switch State programmed to be STANDBY SPEED (Factory Preset Value)
While the Set switch wire input is open (or between 1.4V and 3.3V), then engine speed will go to 850 RPM (Factory preset value for STANDBY SPEED)

Note: The Remote Set Input can be reprogrammed so that the High Voltage = SET SPEED 1 or SET SPEED 2

(continued on Page 13)

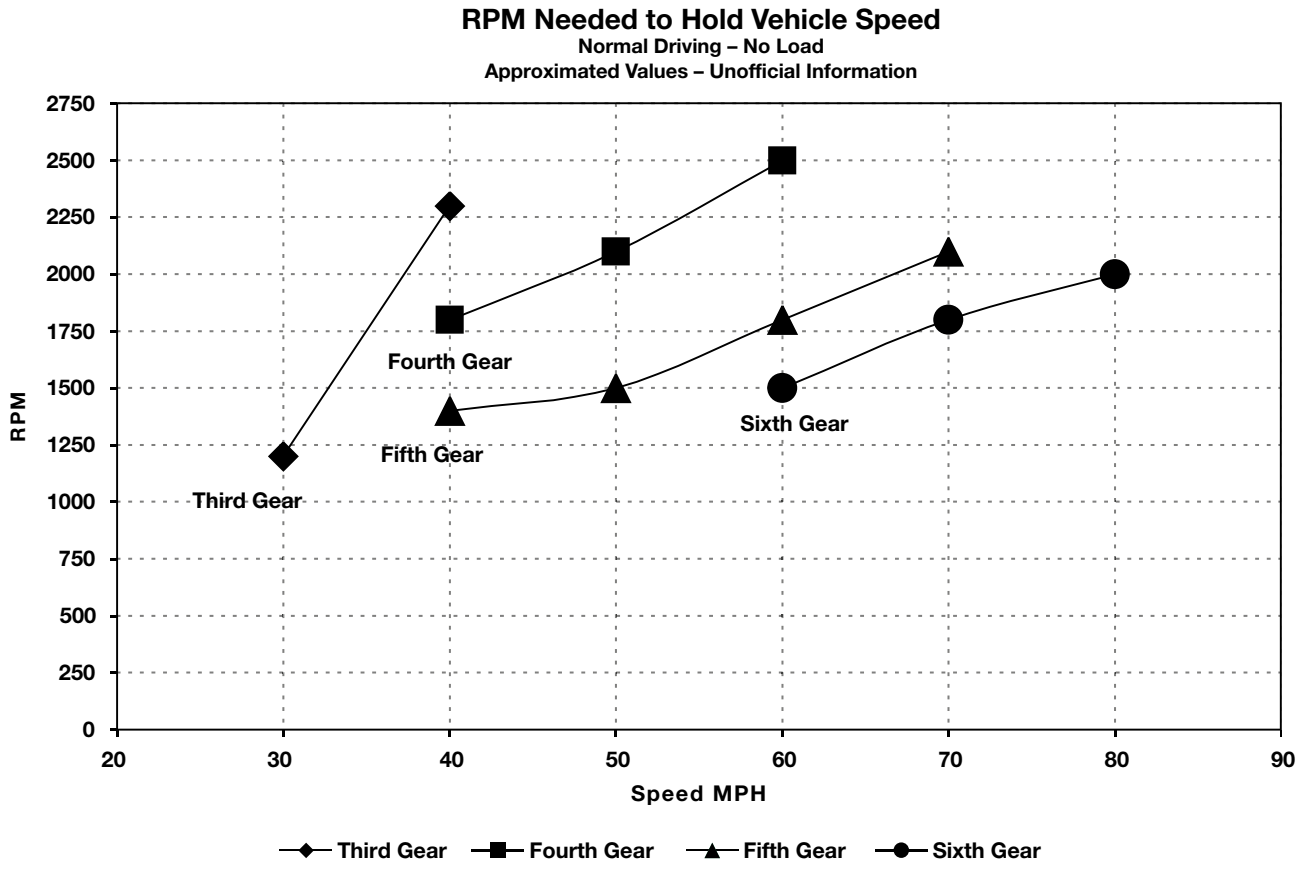
5. Engine Speed Control Modes (cont'd)

5.2. Variable PTO Mode

In this mode, the vehicle can be programmed for stationary or mobile operation. The variable PTO mode controls engine speed and PTO load engagement is selected by either the PTO in-cab or remote switches. Engine speed selection is variable between base engine idle speed and a maximum of 3100 rpm (factory setting 2100 rpm).

In the mobile PTO mode, the vehicle will operate at a vehicle speed resulting from the current PTO engine speed request and current transmission gear range selected.

Vehicle speed stability is greatly improved by shifting into the transmission manual mode because upshifts are limited. This reduces the maximum vehicle speed while allowing high engine speed operation. Therefore, low vehicle speed operation (10-25 mph) (16-40 km/h) and high PTO engine speed (1,500 -2,000 rpm) can be achieved in the manual mode 1 and 2 transmission ranges.



Drawing 5.2

(continued on Page 14)

5. Engine Speed Control Modes (cont'd)

5.2. Variable PTO Mode

Table 2. Variable PTO Mode Function Table

Applied Switch	PTO Relay		Resulting Engine RPM	
Remote Set Switch or In-Cab Switch (1)	**Initial State**	**Resulting State**	**Short Apply of Switch** *less than 1.3 seconds*	**Long Apply of Switch** *greater than 1.3 seconds*
I	"OFF"	"ON"	"ON" RPM will increase to Standby Speed (850 RPM) Or Base Engine Idle (if greater than standby speed) Or Accelerator Commanded RPM (1500 Max)	NO ACTION RPM remains at that commanded by accelerator
O	"ON" or "OFF"	"OFF"	"OFF" RPM will decrease to Base Idle or that commanded by the accelerator	"OFF" RPM will decrease to Base Idle or that commanded by the accelerator
SET −	"OFF"	"OFF"	NO ACTION RPM remains at that commanded by the accelerator	NO ACTION RPM remains at that commanded by the accelerator
RES +	"OFF" (No Memory RPM Stored)	"OFF"	NO ACTION RPM remains at that commanded by the accelerator	NO ACTION RPM remains at that commanded by the accelerator
SET −	"ON"	"ON"	SET RPM will increase to that commanded by the accelerator	NO ACTION RPM remains at that commanded by the accelerator
RES +	"OFF" (No Memory RPM Stored)	"ON"	RESUME MODE RPM increases to operating RPM at time the brake pedal is pressed during PTO operation	ACCEL MODE RPM increases at 200 RPM/sec* until switch is released or max PTO operating RPM is reached
SET −	"ON"	"ON"	TAP-DOWN MODE RPM is decremented by 100 RPM*	COAST MODE RPM decreases at 200 RPM/sec* until switch is released or standby RPM is reached
RES +	"ON"	"ON"	TAP-UP MODE RPM is incremented by 100 RPM*	ACCEL MODE RPM increases at 200 RPM/sec* until switch is released or max PTO operating RPM is reached

(continued on Page 15)

5. Engine Speed Control Modes (cont'd)

5.2.1. In-cab PTO Switch Operation

In the variable PTO mode, the in-cab PTO switch shall operate as follows:

ON:

To engage PTO, press and release the in-cab

switch position. The vehicle will increase engine speed to a factory preset engine speed (850 rpm). This PTO stand-by speed is not intended to be an operational PTO speed, but allows the engagement of the PTO at lower initial start-up rpm to match with the engagement of the PTO load relay.

The initial stand-by speed can be adjusted by holding the accelerator to the desired engine speed, then pressing and releasing the in-cab

PTO switch position. The current engine speed will become the new stand-by speed for the duration of the PTO "ON" cycle. This adjustment can only be done once at the initial engagement of PTO. The initial stand-by speed adjustment must be between engine base idle speed and 1500 rpm (maximum PTO engage speed). The new standby speed is not retained after PTO is disabled (or turned off).

OFF:

Press and release the in-cab

switch position or push the remote enable switch to "OFF" to disengage PTO. The engine speed will be reduced to the base idle speed and the PTO load relay will be disengaged.

SET:

Press and hold the accelerator to obtain the desired engine speed, then press and release the in-cab

position of the PTO switch. The current engine speed will be maintained. This action can be repeated as desired to a higher rpm value. The PTO set speed cannot exceed 2100 rpm (factory preset, max setting 3100 rpm).

TAP-DOWN:

Press and release the in-cab

switch position on the PTO switch to reduce the engine speed by increments of 100 rpm.

COAST:

Press and hold the in-cab

switch position on the PTO switch to reduce the rpm by 200 rpm per second until the desired engine speed is reached or until the initial PTO standby speed is reached.

RESUME:

When a PTO set speed has been achieved, press and release the brake pedal. Engine speed will reduce to basic idle speed. The PTO LED will blink slowly indicating the previous PTO set speed has been retained in memory.

Press and release the in-cab

switch position to resume the previous PTO set speed. The PTO set speed cannot exceed 2100 rpm (factory preset, max setting 3100 rpm).

TAP-UP:

Press and release the in-cab

position to increase the engine speed by increments of 100 rpm.

ACCEL:

Press and hold the in-cab

position to increase the rpm by 200 rpm per second until the desired engine speed is reached or until the maximum allowable PTO set speed is reached.

5.2.2. Remote PTO Switch Operation

In the variable PTO mode, the remote PTO switch shall operate as follows:

Remote PTO Enable (ON/OFF Switch)

To engage PTO, press and release the remote PTO arming switch, then within five seconds, move the PTO enable switch from "OFF" to "ON" (open to closed). The vehicle will increase engine speed to a factory preset engine speed (800 rpm). This PTO stand-by speed is not intended to be an operational PTO speed, but allows the engagement of the PTO at lower initial start-up rpm to match with the engagement of the PTO load relay.

Remote PTO SET Switch

In the variable PTO mode, the remote PTO set switch can be programmed to operate as a momentary switch, only. The switch operates the same way as the in-cab PTO switch.
See section 5.2, Table 2.

6. Remote Engine Start and Shutdown Control

6.1. Remote Engine Shutdown

The vehicle's PTO system allows for remote engine shutdown while operating in the stationary PTO mode. This feature has the following functions:

- **Engine shutdown using the operator remote switch:** The vehicle wiring system provides remote engine shutdown switch connections, which is accessed through the PTO upfitter connector.
- **Timed auto-engine shutdown:** The timed auto-engine shutdown feature provides the means to shut down the engine automatically after a predefined time. PTO must be operational for this function to be active.
- **Engine shutdown based on critical engine conditions:** The engine will be shutdown when PTO is operating if a critical engine condition is detected by the vehicle system (i.e., low oil, low oil pressure, hot engine, hot transmission, low fuel, diesel particulate filter regeneration). If PTO operation is continued when critical engine conditions are present, a horn chirp warning will occur after 2 to 5 minutes. The engine will be shutdown 2 minutes after the horn warning. The operator can restart the engine with the ignition key or with the PTO remote engine start controls. The above horn warning and engine shutdown will again occur if the critical engine condition is still present.

6.2. Remote Engine Start

The vehicle's PTO system allows the engine to be remotely started while operating in the stationary PTO mode. The vehicle wiring system provides for connections to a remote engine start arming switch and remote starting switch. These connections are accessed through the upfitter connector.

The remote start function is initiated by a sequence of switch actions, in addition to several vehicle conditions.

The following conditions must be met before attempting to remote start the engine. The vehicle ignition key can be in any position or removed from the ignition.

- The vehicle must be configured for stationary PTO operation by the dealer.
- The parking brake must be set.
- The transmission shift lever must be in PARK (P).
- The vehicle hood must be closed.

Once the above conditions are met, to continue with the remote start, do the following using the remote PTO controls:

1. Press and release the remote start arming switch.
2. Within five seconds of releasing the remote start arming switch, press and hold the remote engine start switch for about two seconds until the engine starts. Release the remote engine start switch.

To enable normal PTO operation following a remote start event, press and release the arming switch. Then within five seconds, the PTO remote enable switch must be toggled from "OFF" to "ON". The PTO system will then elevate engine rpm to standby speed and engage the PTO load. Press the remote PTO -/SET or +/RES switch to elevate PTO to the desired engine operating speed.

See your dealer for additional information on the PTO system and settings.

7. Reprogramming PTO

The Tech II scan tool must be used to change PTO options and adjust the factory preset parameters to the desired settings. The scan tool menu driven device is a hand held and plugs into the data link connector located underneath the dash near the driver's seat. Once the scan tool is connected, the following chart will guide the user.

7.1. PTO Configuration Mode Setting

Once the mode of operation is selected the Current PTO Settings menu will appear with the adjustable parameters for the current mode.

This screen allows the user to increase or decrease engine RPM values using the INCREASE and DECREASE buttons. If the Engine Fault Shutdown feature is selected, the YES or NO Buttons will determine if this feature is enabled.

Important: Please be aware that PTO high idle settings must be reprogrammed in the event that the PTOM is replaced. It may be advisable to provide the PTOM settings information to the customer in case the PTOM requires servicing during some point in the life of the vehicle. Please be aware that the PTO 'engage relay' is disabled in factory programming and must be changed when a relay is installed. [This is the most common field complaint - no relay engagement].

After all the settings are adjusted, the user will press the REPROGRAM button and the Current PTO Settings menu will appear with the changes. The ignition must be turned "OFF" for 2 to 5 minutes with the scan tool disconnected to assure all modules go to sleep and thus ensure that the program values are stored in the PTOM.

Note: Any time PTOM parameters are reprogrammed it is advisable to review the ECM PTO options to be sure they are synchronized [matching for all parameters shown] with the PTOM.

7.2. PTO Factory Default Settings

Programmable Parameters	Factory Setting	Minimum Value	Maximum Value
PTO Type (Available in MY2009, BCM will no longer require programming)	PRESET	PRESET	
		VARIABLE	
		MOBILE	
PTO In-cab Control	ENABLED	DISABLED	ENABLED
PTO Remote Control	DISABLED	DISABLED	ENABLED
Type of Set Switch	MOMENTARY	MOMENTARY	LATCHING
Press "ON" then go to Preset 1 Speed	DISABLED	DISABLED	ENABLED
Remote Engine Start	DISABLED	DISABLED	ENABLED
Remote Engine Shutdown	DISABLED	DISABLED	ENABLED
Load Feedback	DISABLED	DISABLED	ENABLED
Engage Relay	***DISABLED***	***DISABLED***	ENABLED
Keep Relay engage during braking	DISABLED	DISABLED	ENABLED
Action after brake is released	RETURN TO BASE IDLE RPM	RETURN TO BASE IDLE RPM RETURN TO STANDBY RPM	
Auto Engine Shutdown Timer	ENABLED	DISABLED	ENABLED
Engine Shutdown due to Critical Engine Condition	DISABLED	DISABLED	ENABLED
Engine Shutdown warning	DISABLED	DISABLED	ENABLED
Set Low Fuel level for Engine Shutdown	15%	0	25%
Engine Run Time While PTO is Active - Timer	7 hours	4 minutes	7 hours

(continued on Page 19)

Programmable Parameters	Factory Setting	Minimum Value	Maximum Value
PTO Type (Available in MY2009, BCM will no longer require programming)	PRESET	PRESET	
		VARIABLE	
		MOBILE	
PTO Standby RPM*	850	500 RPM Normal engine idle will not override if higher than Standby Speed	3100
PTO Preset 1 Speed*	1250	500 RPM PTO Set Speed 1 cannot be set below PTO Standby speed	3100
PTO Preset 2 Speed*	1700	500 RPM PTO Set Speed 2 cannot be set below PTO Standby speed	3100
Maximum PTO Operating Speed	2100 RPM	500 RPM	3100 RPM
Tap Step	100 RPM	4 RPM	500 RPM
Ramp Rate	200 RPM	4 RPM	1000 RPM
Maximum Vehicle Speed	129 km/h	30 km/h	129 km/h
Minimum Remote Accelerator Voltage	0.25 V	0.0	2.5 V
Maximum Remote Accelerator Voltage	4.75 V	2.5	5.0 V
Remote Set Switch Transition to Low Voltage (<1.66 V)	SET_SPEED 1	STANDBY SPEED SET_SPEED 1 SET_SPEED 2	
Remote Set Switch Transition to Open State (between >1.66 V and <3.33 V)	PTO_STANDBY	STANDBY SPEED SET_SPEED 1 SET_SPEED 2	
Remote Set Switch Transition to High Voltage <3.33 V)	SET_SPEED 2	STANDBY SPEED SET_SPEED 1 SET_SPEED 2	

If the PTO factory preset parameters do not match the settings described above, then they may have already been altered in order to satisfy the requirements of the installed PTO system and body equipment.

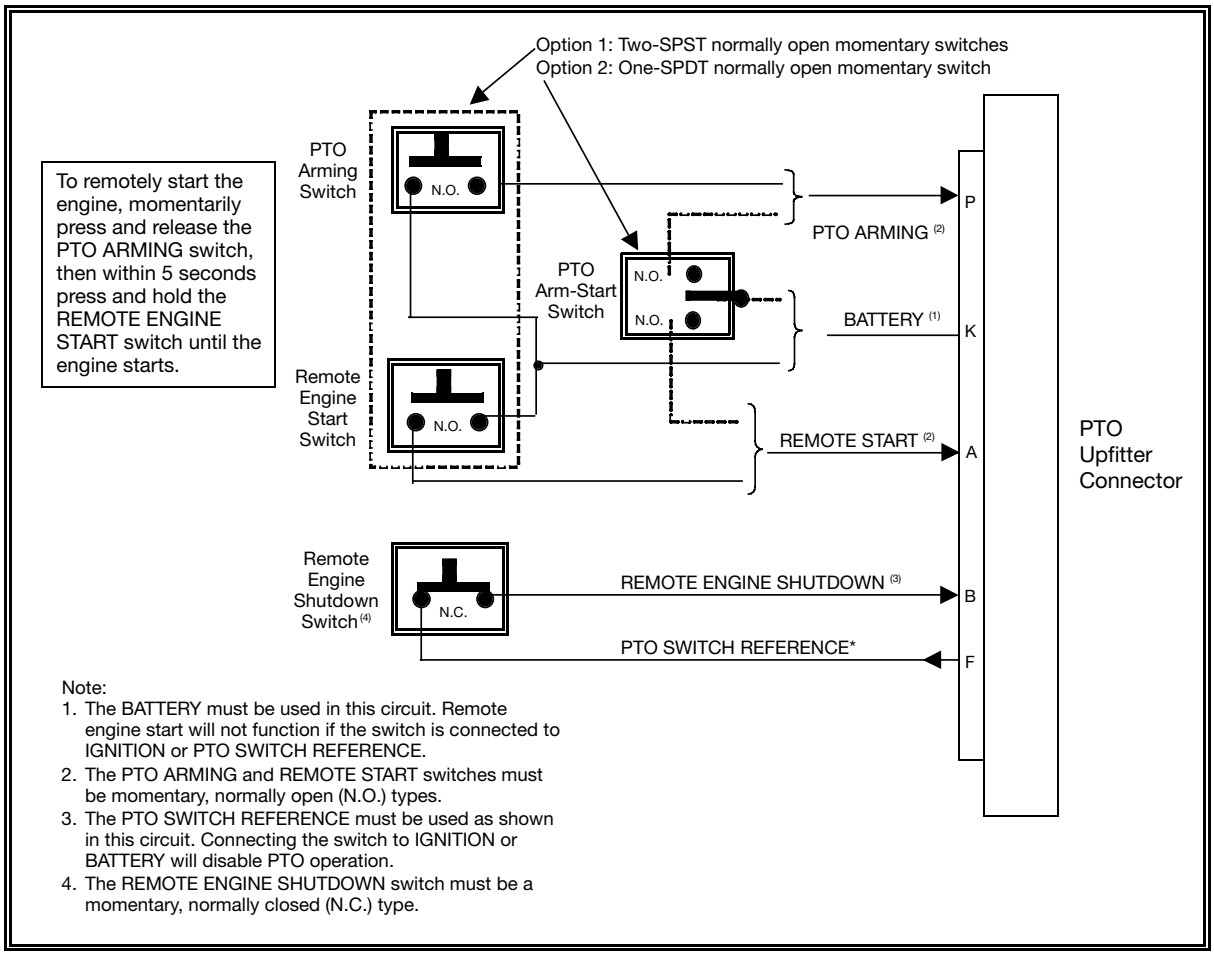
*** Note - Standby, Set 1 and Set 2 speeds should always be seperated 50 RPM or more. All PTO engine speeds must follow this requirement [PTO Max Engine Speed > Set 2 > Set 1 > Standby]**

8. PTO Electrical Wiring Connections

Electrical wiring connections for the various PTO functions are shown the following sub-sections. The PTO upfitter will combine these circuits as required to meet the needs of their particular PTO application. Reference Section 10, Appendix B for examples of how these circuits are combined to make up a complete PTO vehicle application.

8.1. Remote Engine Start Switch Circuit

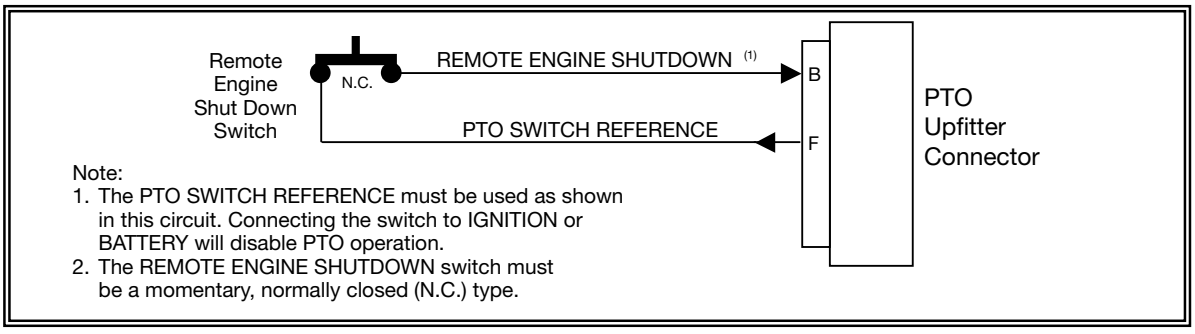
Figure 3



Note:
1. The BATTERY must be used in this circuit. Remote engine start will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
2. The PTO ARMING and REMOTE START switches must be momentary, normally open (N.O.) types.
3. The PTO SWITCH REFERENCE must be used as shown in this circuit. Connecting the switch to IGNITION or BATTERY will disable PTO operation.
4. The REMOTE ENGINE SHUTDOWN switch must be a momentary, normally closed (N.C.) type.

8.2. Remote Engine Shutdown Switch Circuit

Figure 4



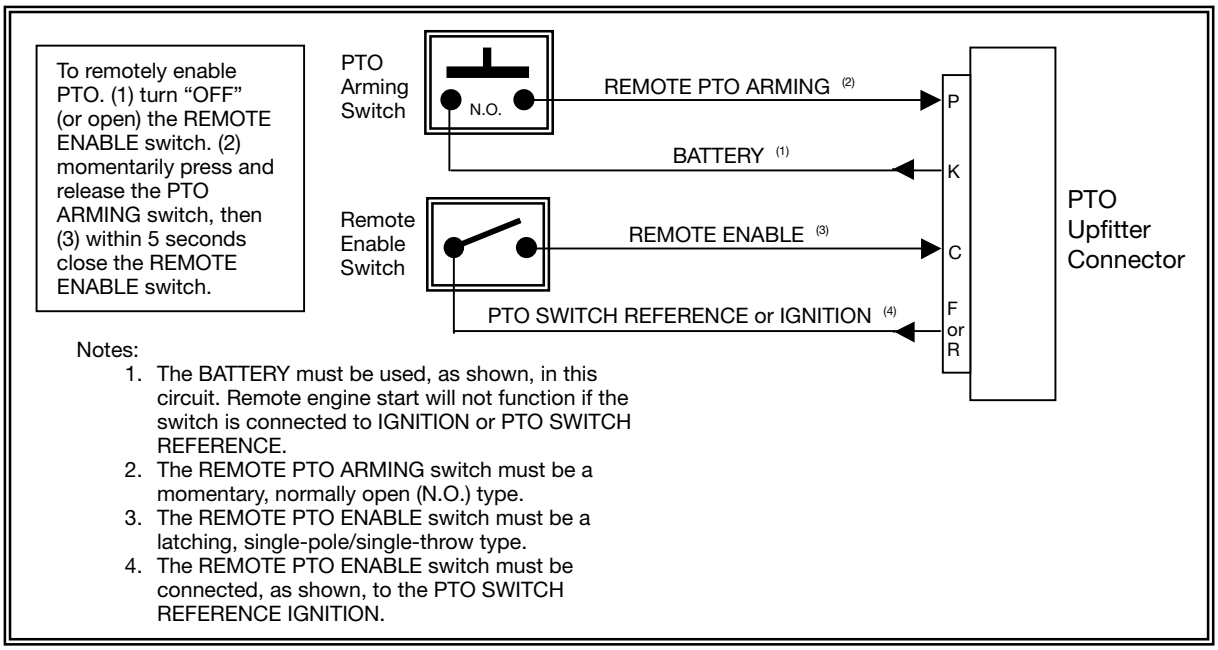
Note:
1. The PTO SWITCH REFERENCE must be used as shown in this circuit. Connecting the switch to IGNITION or BATTERY will disable PTO operation.
2. The REMOTE ENGINE SHUTDOWN switch must be a momentary, normally closed (N.C.) type.

(continued on Page 21)

8. PTO Electrical Wiring Connections (cont'd)

8.3. Remote PTO Arming and Enable (On/Off) Switch Circuits

Figure 5

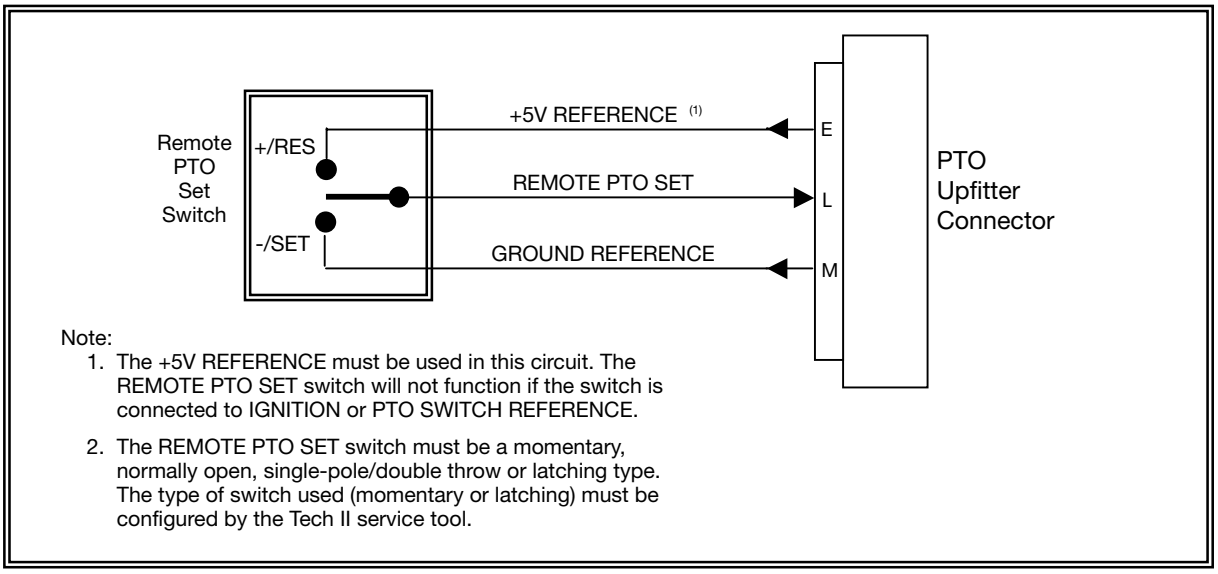

To remotely enable PTO. (1) turn "OFF" (or open) the REMOTE ENABLE switch. (2) momentarily press and release the PTO ARMING switch, then (3) within 5 seconds close the REMOTE ENABLE switch.
PTO Arming Switch
N.O.
REMOTE PTO ARMING (2)
BATTERY (1)
Remote Enable Switch
REMOTE ENABLE (3)
PTO SWITCH REFERENCE or IGNITION (4)
P
K
C
F or R
PTO Upfitter Connector

Notes:

1. The BATTERY must be used, as shown, in this circuit. Remote engine start will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
2. The REMOTE PTO ARMING switch must be a momentary, normally open (N.O.) type.
3. The REMOTE PTO ENABLE switch must be a latching, single-pole/single-throw type.
4. The REMOTE PTO ENABLE switch must be connected, as shown, to the PTO SWITCH REFERENCE IGNITION.

8.4. Remote PTO Set Speed Switch Circuit

Figure 6



Note:

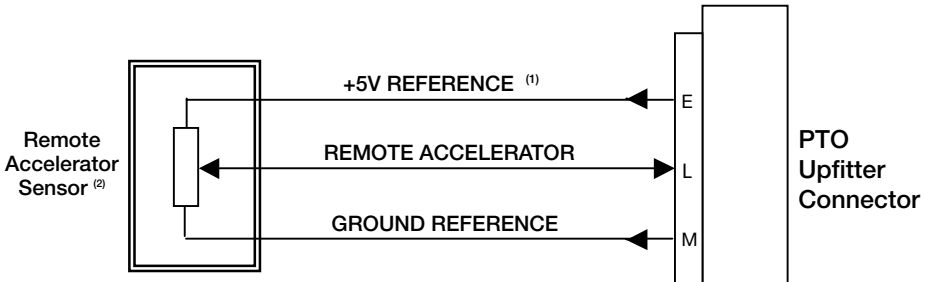
1. The +5V REFERENCE must be used in this circuit. The REMOTE PTO SET switch will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
2. The REMOTE PTO SET switch must be a momentary, normally open, single-pole/double throw or latching type. The type of switch used (momentary or latching) must be configured by the Tech II service tool.

(continued on Page 22)

8. PTO Electrical Wiring Connections (cont'd)

8.5. Remote Accelerator Circuit

Figure 7



Notes:

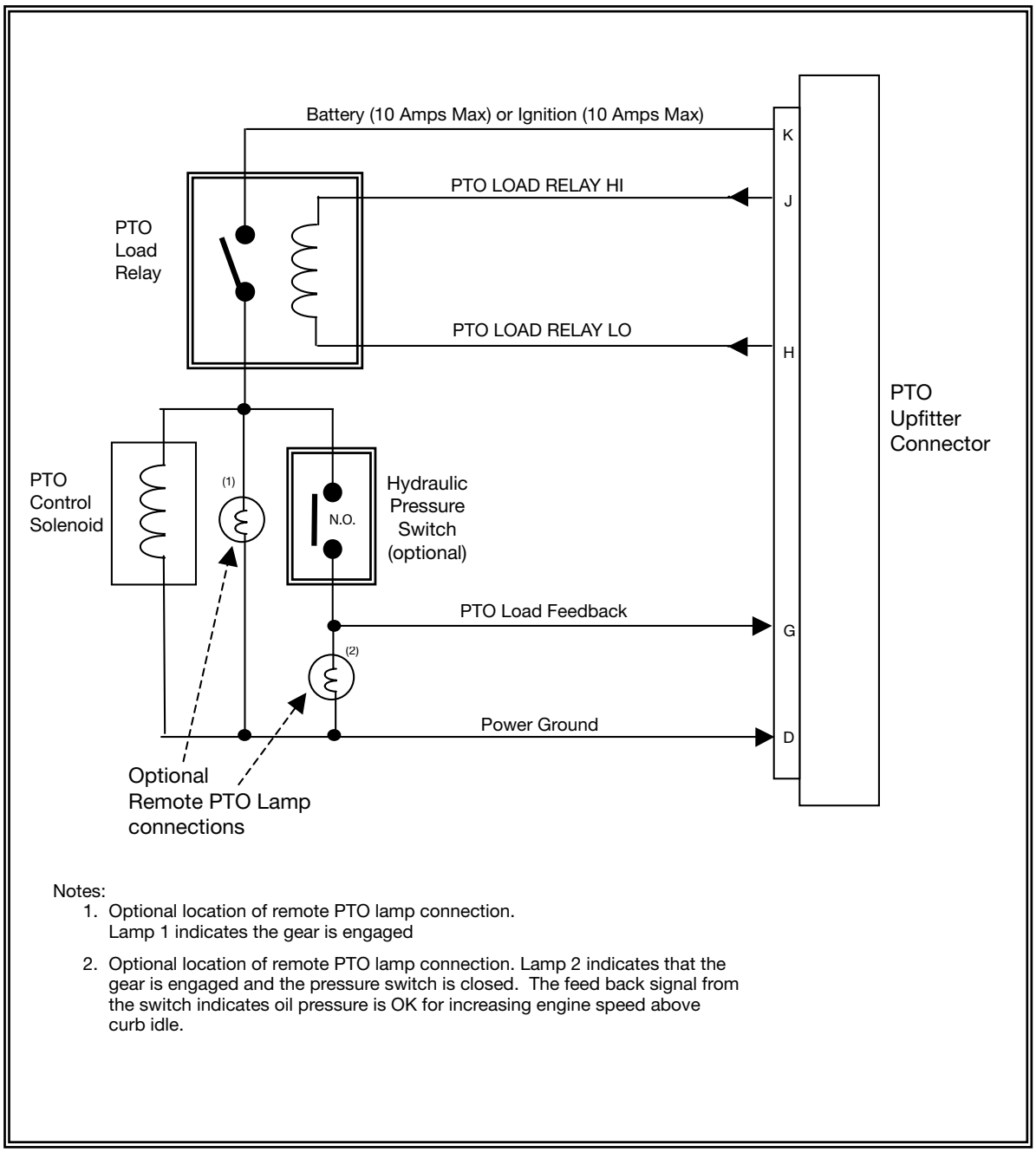
1. The +5V REFERENCE must be used in this circuit. The REMOTE ACCELERATOR sensor will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
2. The REMOTE ACCELERATOR sensor may be a 1 to ten turn potentiometer type with a maximum wiper resistance from 1K ohms to 10K ohms. The PTO In-Cab switch and REMOTE SET switch are disabled when the PTO system is configured to use the REMOTE ACCELERATOR. The REMOTE ACCELERATOR feature must be enabled by the Tech II service tool. Confer with dealership or your upfitter for more information.

(continued on Page 23)

8. PTO Electrical Wiring Connections (cont'd)

8.6. PTO Load Relay and Load Feedback Circuits

Figure 8



Notes:

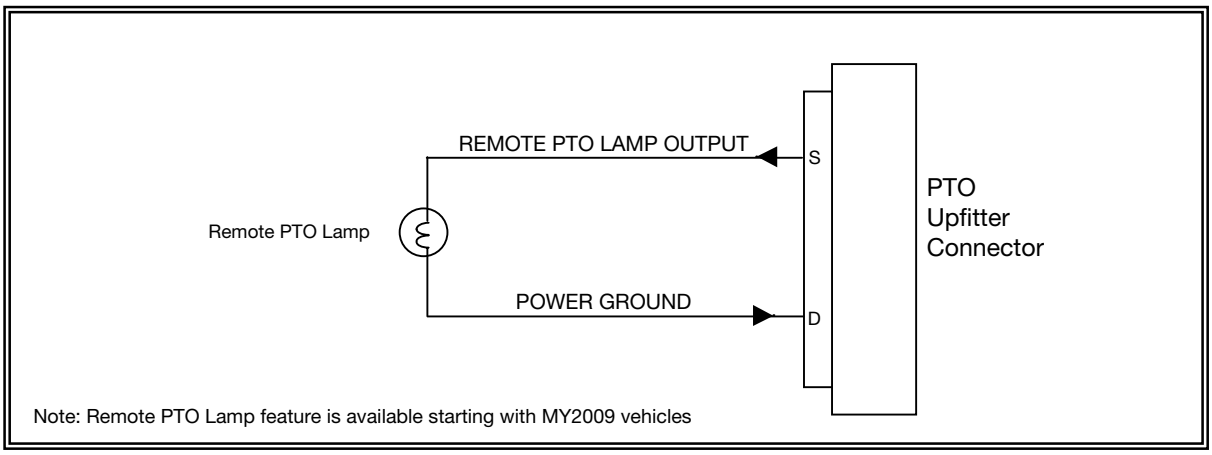
1. Optional location of remote PTO lamp connection. Lamp 1 indicates the gear is engaged
2. Optional location of remote PTO lamp connection. Lamp 2 indicates that the gear is engaged and the pressure switch is closed. The feed back signal from the switch indicates oil pressure is OK for increasing engine speed above curb idle.

(continued on Page 24)

8. PTO Electrical Wiring Connections (cont'd)

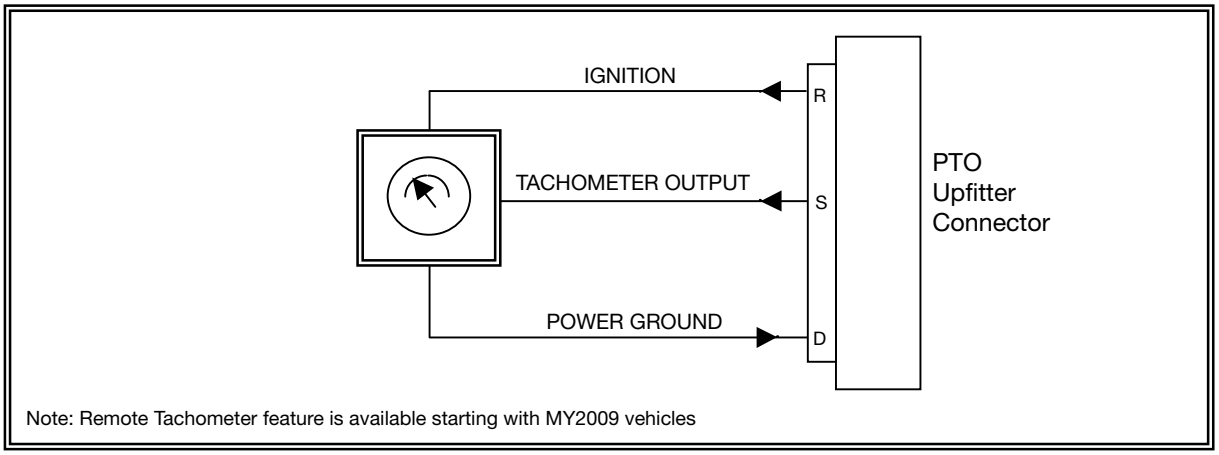
8.7. Remote PTO Indicator Circuit (MY2009 or later)

Figure 9



8.8. Remote Tachometer Circuit (MY2009 or later)

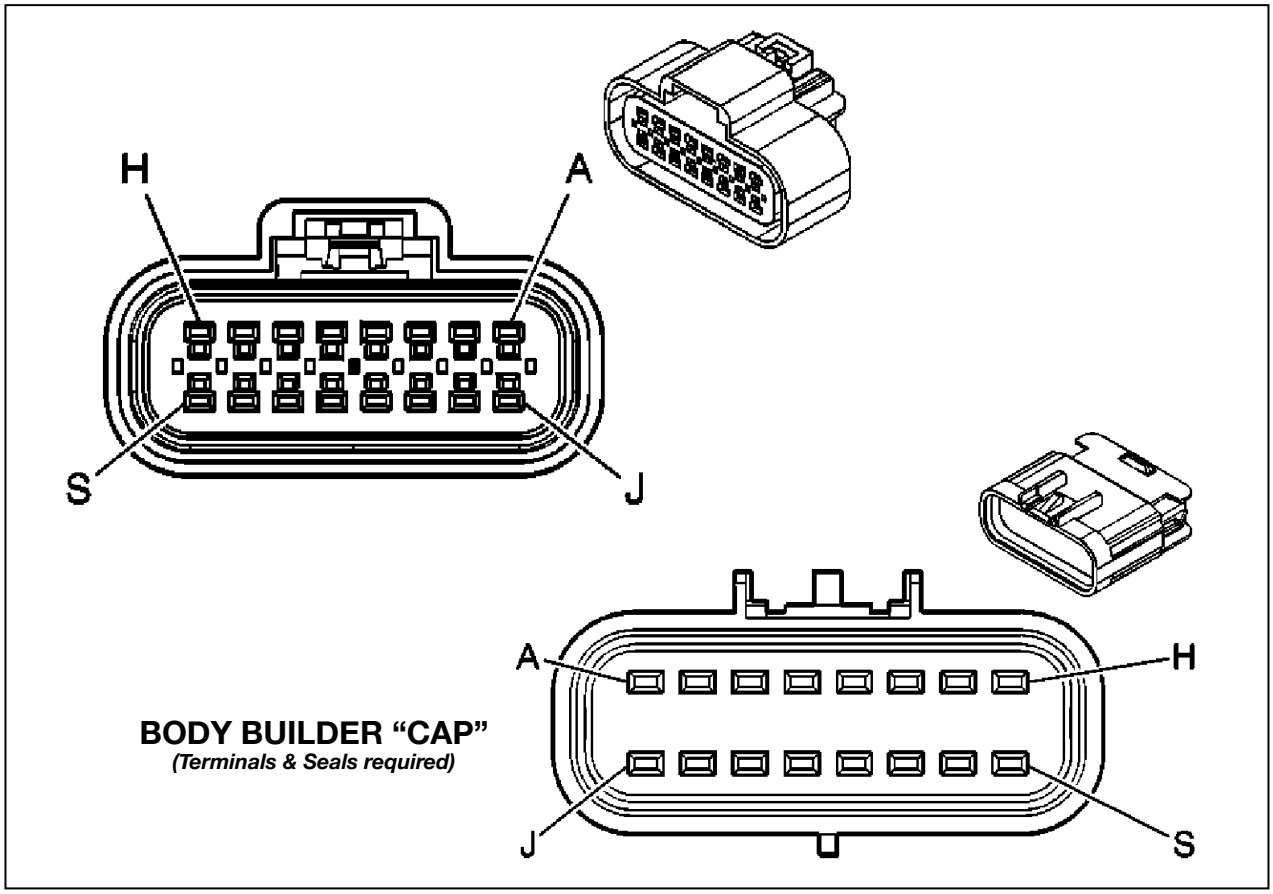
Figure 10



9. APPENDIX A: Upfitter Mating Connector Connector (cont'd)

X124 Engine Harness to PTO Jumper Harness (PTO)

9.1. Connector Components **Table 6**



BODY BUILDER "CAP"
(Terminals & Seals required)

Connector Part Information

- OEM: 15326863
- Service: 15306381
- Description: 16-Way F GT 150 Sealed (BK)

Connector Part Information

- OEM: 15326868
- Service: 15306364
- Description: 16-Way M GT 150 Sealed (BK)

(continued on Page 26)

9. APPENDIX A: Upfitter Mating Connector (cont'd)

9.2. Connector Pin Functions

Table 7

Pin	Circuit Number*	Wire Color*	Description
A	6085	BN/WH	Remote Engine Start Input
B	494	L-BU	Remote Engine Shutdown Input
C	978	GY	PTO Remote Enable Input
D	550	BK	Power Ground
E	975	WH	+5 volt Sensor/Switch Reference (50 ma)
F	6142	D-GN/WH	PTO Switch Reference Output (300 ma)
G	2522	YE	PTO Load Feedback
H	2562	PU	PTO Relay Low-Side Control Output
J	6381	BN	PTO Relay High-Side Control Output
K	2640	RD/WH	Battery (10 Amp Fused) Output
L	6089	D-BU/WH	PTO Remote Set A Input
M	976	GY/BK	Ground Reference
N	977	L-BU	PTO Remote Accelerator Input
P	979	D-BU	Remote Start Arming
R	239	PK	Ignition (Switched Run/Crank)
S	981	TN	PTO Remote Indicator Lamp/Remote Tachometer (MY2009 Vehicles only)

* Vehicle harness Circuit Number and Wire Color

10. APPENDIX B: PTO APPLICATIONS

The following diagrams and tables show the suggested PTO circuit wiring and recommended programmable settings. Use of the GM Tech II service tool is required to reprogram PTO. These are guidelines for setting up you PTO truck which can me adjusted to better meet the intended PTO application. The Tech II service Tool is used to adjust the PTO settings in the ECM and PTOM.

Note: If the vehicle has personalization, disconnection of the battery or a dead battery condition will cause the loss of these settings. The setting will revert back to the original factory settings. Only the personalization setting are reset: Standby Speed, Preset 1 Speed, Preset 2 Speed, Tap-Step Speed and Auto Engine Shutdown Time.

Notes:

1. The BATTERY must be used in this circuit. Remote engine start will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
2. The PTO ARMING and REMOTE START switches must be momentary, normally open (N.O.) types.
3. The PTO SWITCH REFERENCE must be used as shown in the REMOTE SHUTDOWN circuit. Connecting the switch to IGNITION or BATTERY will disable PTO operation.
4. The REMOTE ENGINE SHUTDOWN switch must be a momentary, normally closed (N.C.) type.
5. The PTO REMOTE ENABLE switch must be a latching, single-pole/single-through type.
6. The PTO REMOTE ENABLE switch must be connected, as shown, to the PTO SWITCH REFERENCE.
7. The +5V REFERENCE must be used in the circuit with the REMOTE SET SWITCH. The REMOTE PTO SET switch will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
8. The REMOTE PTO SET switch must be a momentary normal open single-pole / double-through or latching type, The type of switch used (momentary or latching) must be configured by the Tech II service tool.
9. The +5V REFERENCE must be used in the REMOTE ACCELERATOR circuit. The REMOTE ACCELERATOR sensor will not function if the switch is connected to IGNITION or PTO SWITCH REFERENCE.
10. The REMOTE ACCELERATOR sensor may be a 1 to ten turn potentiometer type with a maximum wiper resistance from 1K ohms to 10K ohms. The PTO In-Cab switch and REMOTE SET switch are disabled when the PTO system is configured to use the REMOTE ACCELERATOR. The REMOTE ACCELERATOR feature must be enabled by the Tech II service tool.
11. Optional location of remote PTO lamp connection for MY2007 or later vehicles. This option will indicate when PTO hydraulic system detects the PTO hydraulic pump is providing hydraulic fluid pressure. Which confirms the PTO is engaged and operating.
12. Optional location of remote PTO lamp connection for MY2007 or later vehicles. This option location indicate when the PTO pump has been energized.

(continued on Page 28)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

FACTORY PRESET PARAMETERS					
PTO TYPE		Programmable Parameters	Factory Settings	Minimum Value	Maximum Value
Stationary	Mobile				
■		Set Low Fuel Level for Engine Shutdown	15%	0	25%
■		Engine Run Time While PTO is Active - Timer	7 Hours	4 Minutes	7 Hours
■	■	Max. PTO Engine Speed	2100	950	3100
■	■	Max. PTO Engage Speed	1500 RPM	680 RPM	1800 RPM
■	■	PTO Standby RPM	850	Normal engine idle will override if higher than Standby Speed	3100
■		PTO Preset 1 Speed	1250	680 RPM PTO Set Speed 1 cannot be set below PTO Standby Speed	3100
■		PTO Preset 2 Speed	1700	680 RPM PTO Set Speed 2 cannot be set below PTO Standby Speed	3100
■	■	Tap Step	100 RPM	4 RPM	500 RPM
■	■	Ramp Rate	200 RPM	4 RPM	1000 RPM
	■	Maximum Vehicle Speed	129 km/h	30 km/h	129 km/h
Remote Accelerator Sensor Min./max. Voltage Settings					
■		Minimum Remote Accelerator Voltage	0.25V	0.0	2.5V
■		Maximum Remote Accelerator Voltage	4.75V	2.5V	5.0V
Latch Switch Types (reference Air Compressor or A/C Compressor)					
■		Remote Set Switch Transition to Low Voltage (<1.66V)	SET_SPEED 1	STANDBY SPEED	
				SET SPEED_1	
				SET SPEED_2	
■		Remote Set Switch Transition to Open State (between >1.66V and <3.33V	PTO_STANDBY	STANDBY SPEED	
				SET SPEED_1	
				SET SPEED_2	
■		Remote Set Switch Transition to High Voltage (>3.33V)	SET_SPEED 2	STANDBY SPEED	
				SET SPEED_1	
				SET SPEED_2	

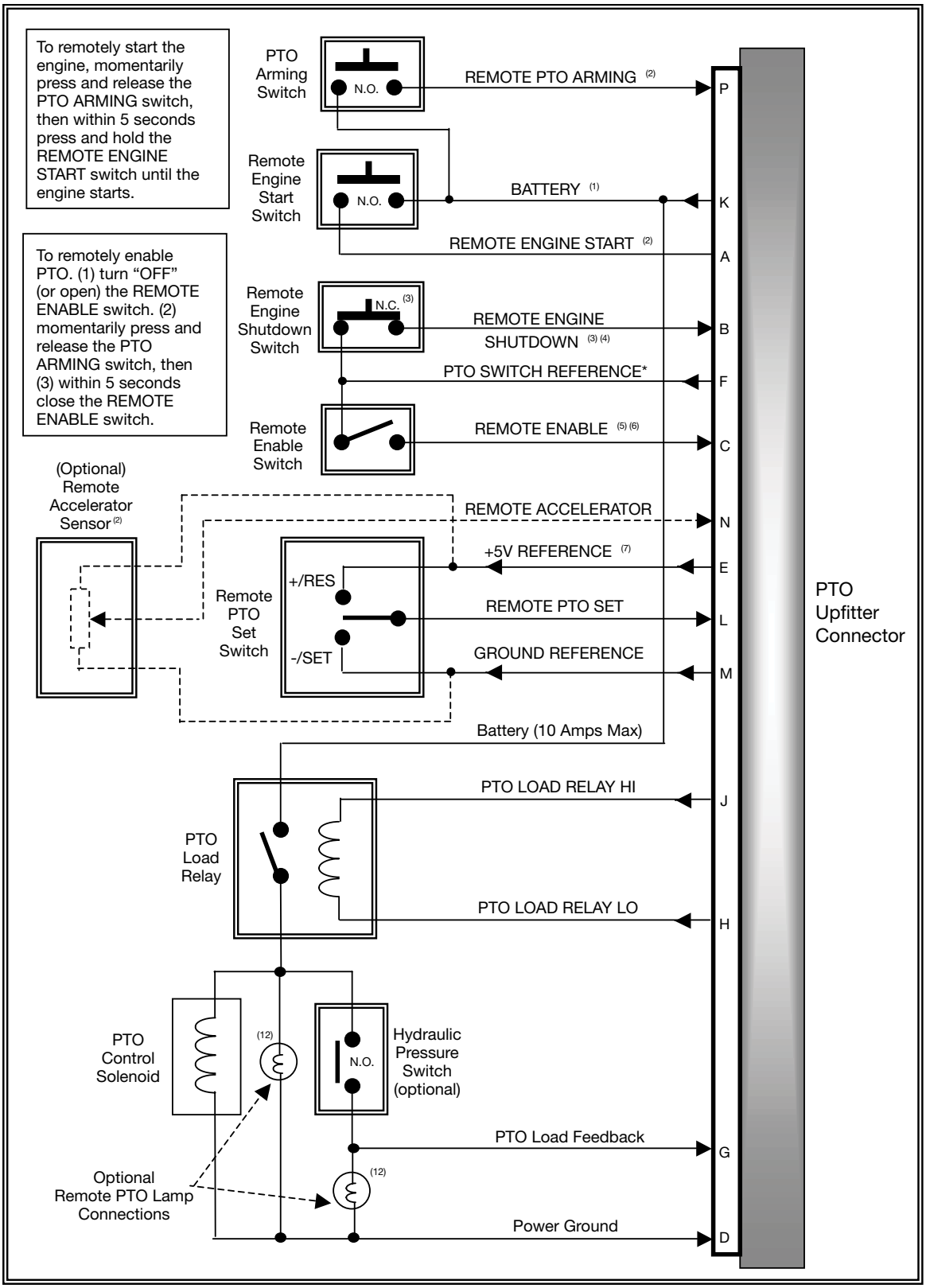
If the PTO factory preset parameters do not match the settings described above, then they may have already been altered in order to satisfy the requirements of the installed PTO system and body equipment. When custom programming the system be sure to check the ECM PTO options to verify they match the PTO module settings. If they mismatch you may not be able to idle up. Operation should be checked immediately after any reprogramming is done.

(continued on Page 29)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.1. Stationary PTO - Full Function System

Figure 11



(continued on Page 30)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

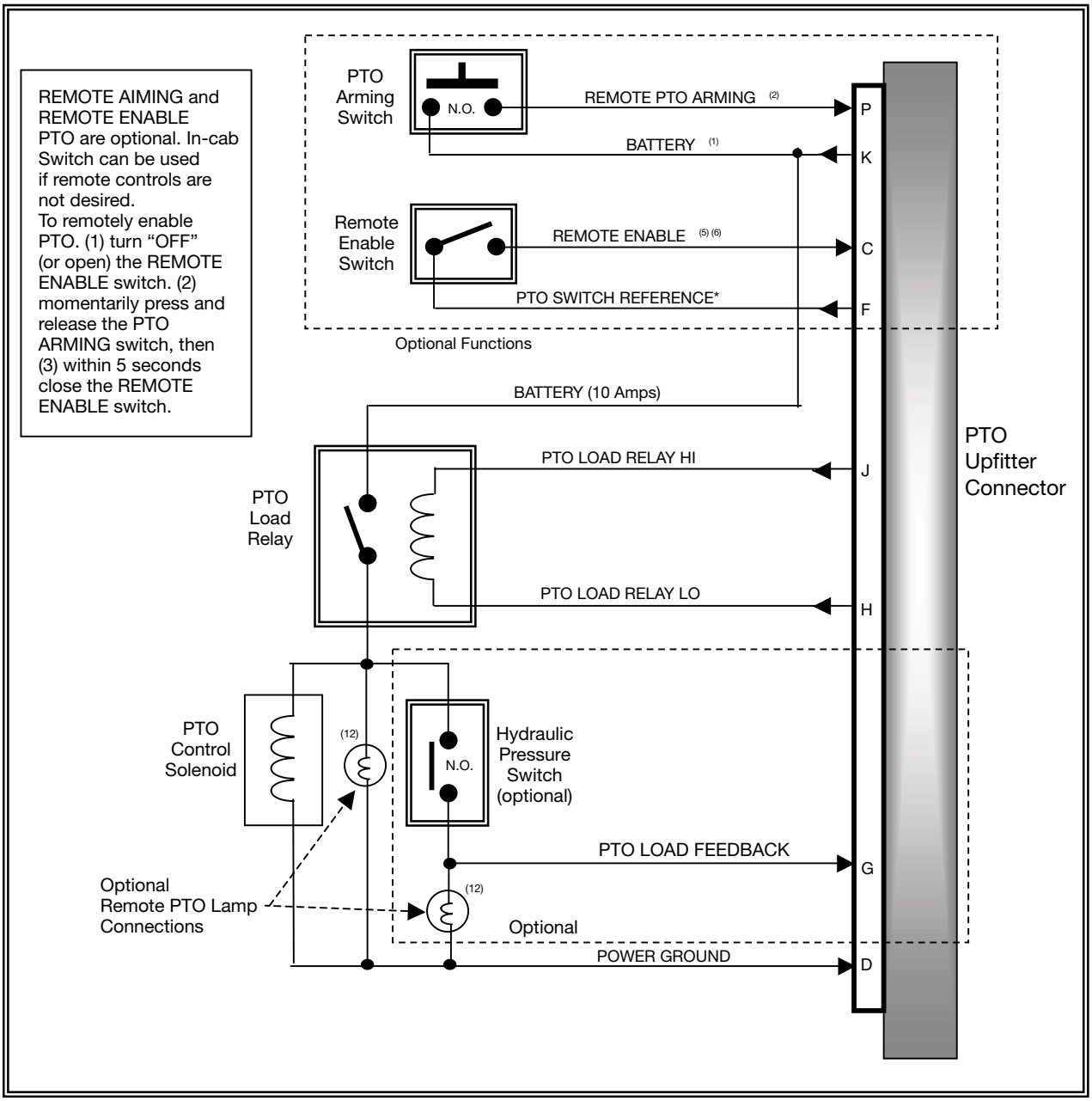
STATIONARY PTO – FULL FUNCTION SYSTEM			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	PRESET	ECM settings must match
PTO In-Cab Control	DISABLED ENABLED	ENABLED	
PTO Remote Control	DISABLED ENABLED	ENABLED	
Type of Set Switch Operation	MOMENTARY LATCHING	N/A	
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	DISABLED	
Remote Engine Start	DISABLED ENABLED	ENABLED	
Remote Engine Shutdown	DISABLED ENABLED	ENABLED	
Load feedback	DISABLED ENABLED	ENABLED	
Engage Relay	DISABLED ENABLED	ENABLED	Engage Relay is DISABLED in factory programming.
Keep Relay engage during braking	DISABLED ENABLED	N/A	
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	N/A	
Auto Engine Shutdown Timer	DISABLED ENABLED	DISABLED	
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	ENABLED	
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

(continued on Page 31)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.2. Tow Truck / Vehicle Hauler

Figure 12



(continued on Page 32)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

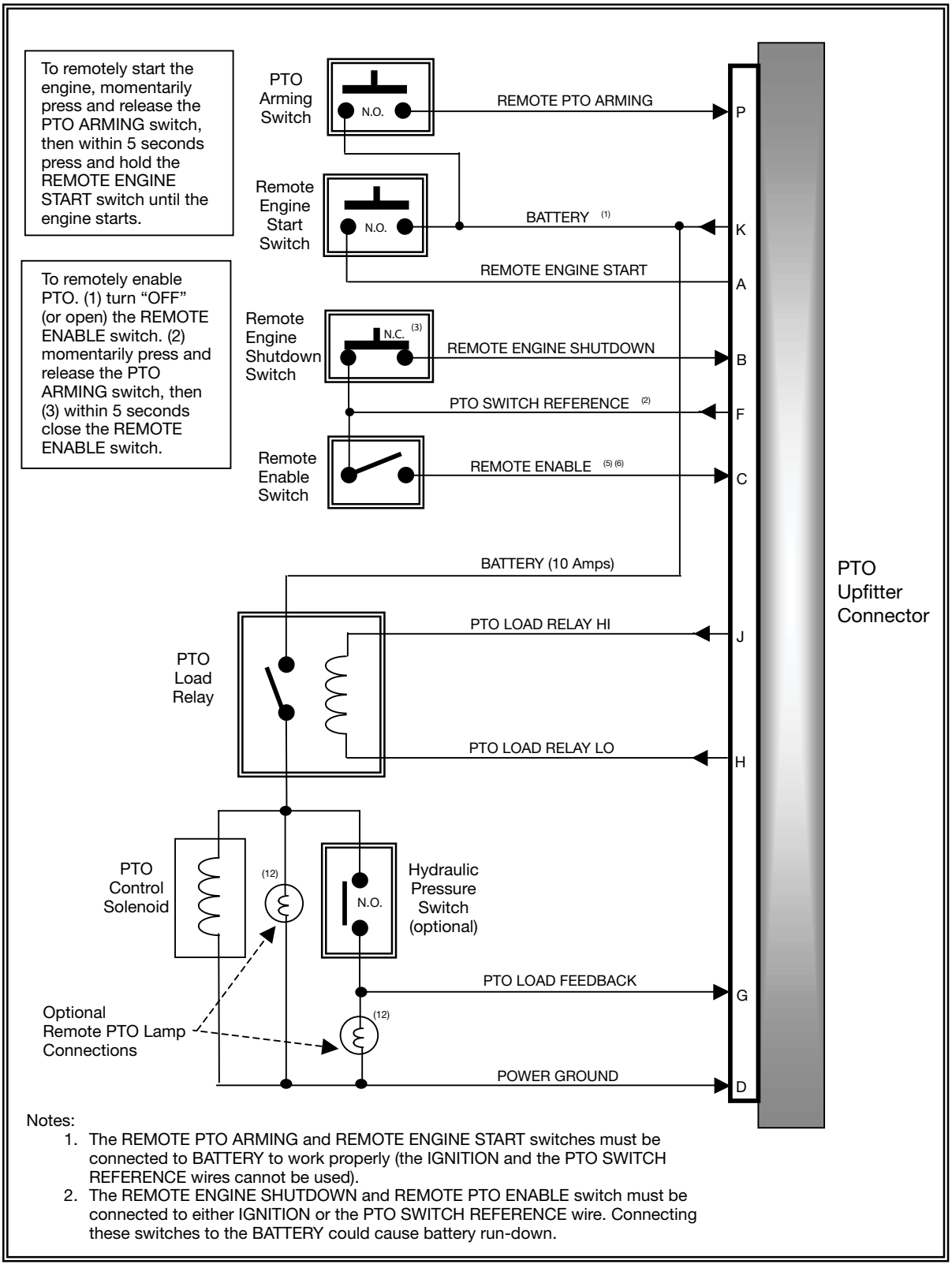
TOW TRUCK – VEHICLE HAULER			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	PRESET	ECM settings must match
PTO In-Cab Control	DISABLED ENABLED	ENABLED	
PTO Remote Control	DISABLED ENABLED	DISABLED	
Type of Set Switch Operation	MOMENTARY LATCHING	N/A	
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	ENABLED	
Remote Engine Start	DISABLED ENABLED	DISABLED	
Remote Engine Shutdown	DISABLED ENABLED	DISABLED	
Load feedback	DISABLED ENABLED	ENABLED	
Engage Relay	DISABLED ENABLED	ENABLED	Engage Relay is DISABLED in factory programming.
Keep Relay engage during braking	DISABLED ENABLED	N/A	
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	RETURN TO BASE IDLE RPM	
Auto Engine Shutdown Timer	DISABLED ENABLED	DISABLED	
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	DISABLED	
Engine Shutdown warning	DISABLED ENABLED	DISABLED	
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

(continued on Page 33)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.3. Lift Bucket / Lift Gate

Figure 13



Notes:

1. The REMOTE PTO ARMING and REMOTE ENGINE START switches must be connected to BATTERY to work properly (the IGNITION and the PTO SWITCH REFERENCE wires cannot be used).
2. The REMOTE ENGINE SHUTDOWN and REMOTE PTO ENABLE switch must be connected to either IGNITION or the PTO SWITCH REFERENCE wire. Connecting these switches to the BATTERY could cause battery run-down.

(continued on Page 34)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

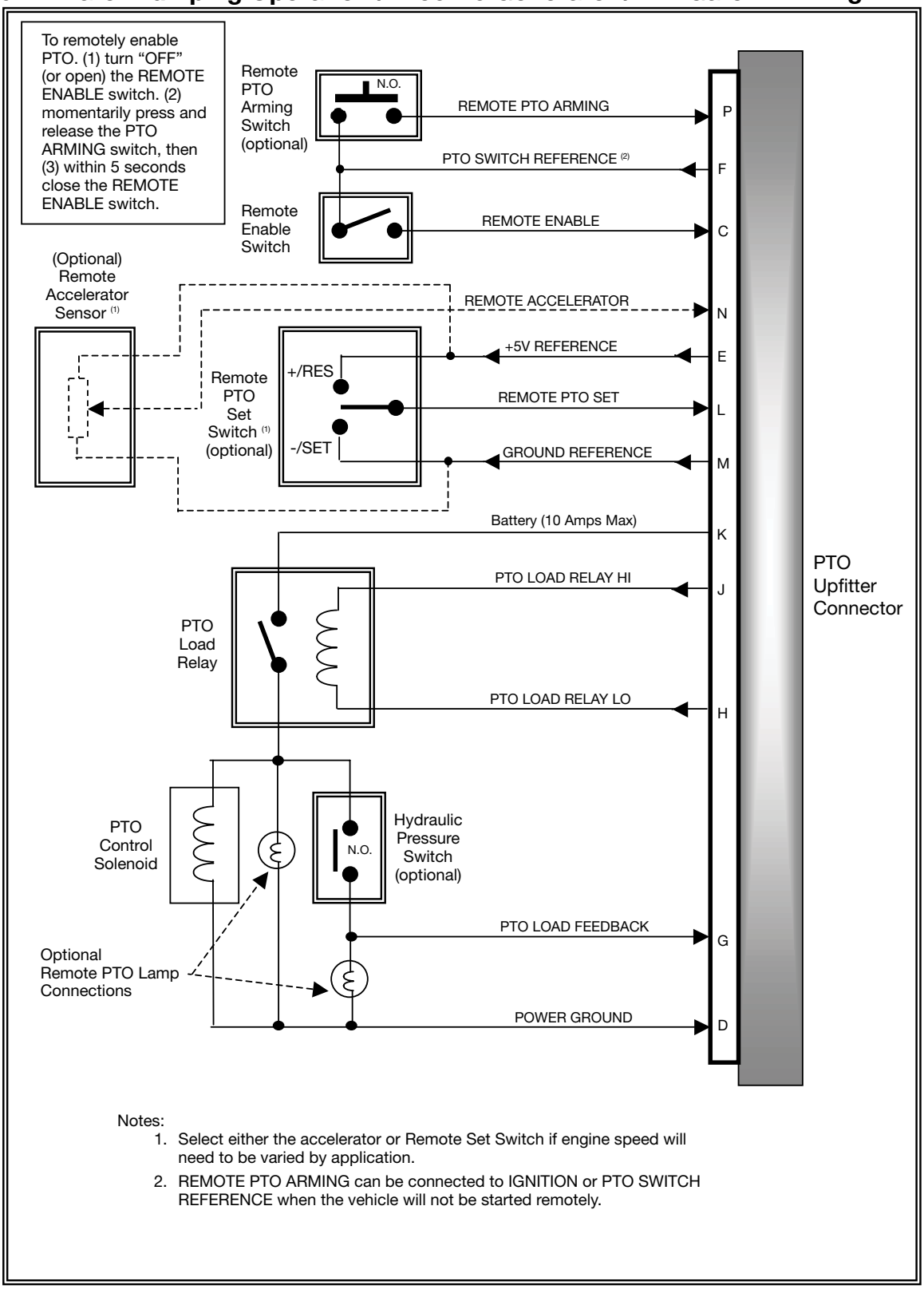
LIFT BUCKET – LIFT GATE			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	PRESET	ECM settings must match
PTO In-Cab Control	DISABLED ENABLED	ENABLED	
PTO Remote Control	DISABLED ENABLED	ENABLED	
Type of Set Switch Operation	MOMENTARY LATCHING	MOMENTARY	
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	ENABLED	
Remote Engine Start	DISABLED ENABLED	ENABLED	
Remote Engine Shutdown	DISABLED ENABLED	ENABLED	
Load feedback	DISABLED ENABLED	ENABLED	
Engage Relay	DISABLED ENABLED	ENABLED	Engage Relay is DISABLED in factory programming.
Keep Relay engage during braking	DISABLED ENABLED	N/A	
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	RETURN TO BASE IDLE RPM	
Auto Engine Shutdown Timer	DISABLED ENABLED	ENABLED	
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	ENABLED	
Engine Shutdown warning	DISABLED ENABLED	ENABLED	
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

(continued on Page 35)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.4. Water Pumping Operation / Electric Generator / Lift Gate

Figure 14



Notes:

1. Select either the accelerator or Remote Set Switch if engine speed will need to be varied by application.
2. REMOTE PTO ARMING can be connected to IGNITION or PTO SWITCH REFERENCE when the vehicle will not be started remotely.

(continued on Page 36)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

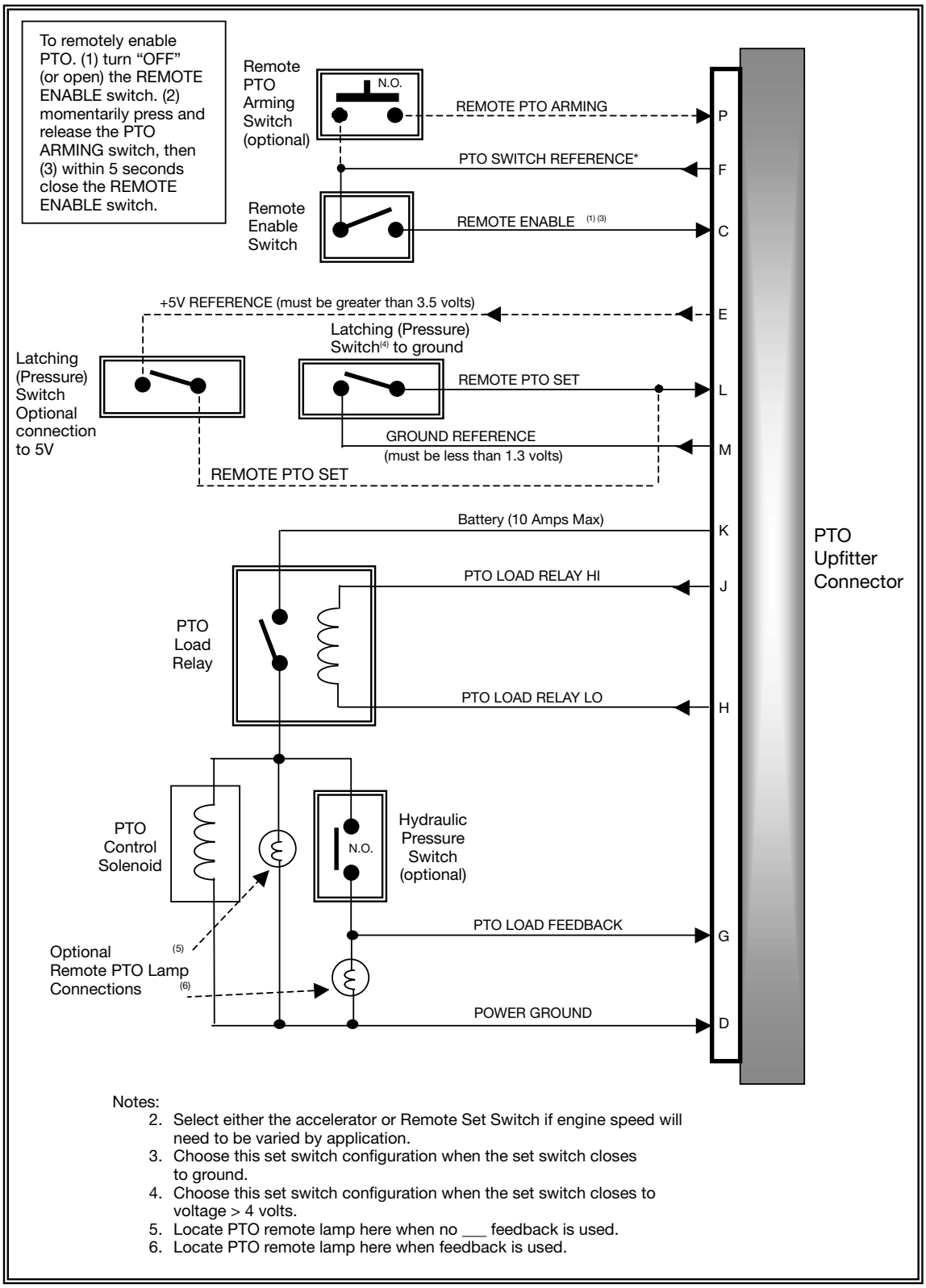
HOLE DRILLING / WATER PUMPING OPERATION / ELECTRIC GENERATOR			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	VARIABLE	ECM settings must match
PTO In-Cab Control	DISABLED ENABLED	DISABLED	
PTO Remote Control	DISABLED ENABLED	ENABLED	
Type of Set Switch Operation	MOMENTARY LATCHING	MOMENTARY	
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	DISABLED	
Remote Engine Start	DISABLED ENABLED	ENABLED	
Remote Engine Shutdown	DISABLED ENABLED	ENABLED	
Load feedback	DISABLED ENABLED	ENABLED	
Engage Relay	DISABLED ENABLED	ENABLED	Engage Relay is DISABLED in factory programming.
Keep Relay engage during braking	DISABLED ENABLED	N/A	
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	RETURN TO BASE IDLE RPM	
Auto Engine Shutdown Timer	DISABLED ENABLED	DISABLED	
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	ENABLED	
Engine Shutdown warning	DISABLED ENABLED	ENABLED	
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

(continued on Page 37)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.5. Air Compressor / A/C Compressor

Figure 15



Notes:

2. Select either the accelerator or Remote Set Switch if engine speed will need to be varied by application.
3. Choose this set switch configuration when the set switch closes to ground.
4. Choose this set switch configuration when the set switch closes to voltage > 4 volts.
5. Locate PTO remote lamp here when no ___ feedback is used.
6. Locate PTO remote lamp here when feedback is used.

(continued on Page 38)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

AIR COMPRESSOR / A/C COMPRESSOR			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	PRESET	
PTO In-Cab Control	DISABLED ENABLED	DISABLED	
PTO Remote Control	DISABLED ENABLED	ENABLED	
Type of Set Switch Operation	MOMENTARY LATCHING	LATCHING	
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	DISABLED	
Remote Engine Start	DISABLED ENABLED	DISABLED	
Remote Engine Shutdown	DISABLED ENABLED	DISABLED	
Load feedback	DISABLED ENABLED	ENABLED	
Engage Relay	DISABLED ENABLED	ENABLED	Engage Relay is DISABLED in factory programming.
Keep Relay engage during braking	DISABLED ENABLED	N/A	
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	RETURN TO BASE IDLE RPM	
Auto Engine Shutdown Timer	DISABLED ENABLED	DISABLED	
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	ENABLED	
Engine Shutdown warning	DISABLED ENABLED	ENABLED	
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

(continued on Page 39)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

10.6. Snow Plow / Salt Spreader / Fertilizer Spreader / Road Grader / Street Sweeper / Dump Box

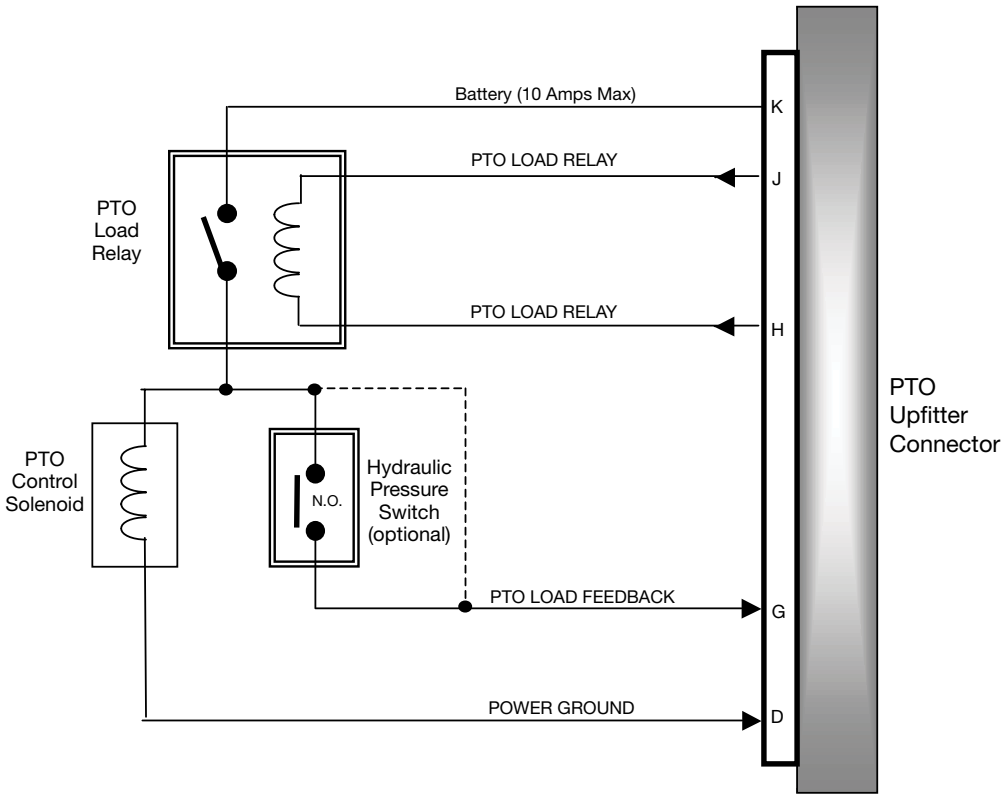
Figure 16

PTO System Type = MOBILE VARIABLE

In this configuration: the remote PTO enable and set controls should be disabled.
The PTO In-cab switch provides all engine speed control functions.

To enable PTO, press and release the I the In-cab PTO switch.

To turn "OFF" PTO, press and release the O of the In-cab PTO switch.



Notes:

(continued on Page 40)

10. APPENDIX B: PTO APPLICATIONS (cont'd)

SNOW PLOW / SALT SPREADER / FERTILIZER SPREADER / ROAD GRADER STREET SWEEPER / DUMP BOX			
Recommended PTO Programmable Settings			
Programmable Parameters	**Programmable Options**	**Recommended Settings**	**Notes**
PTO Type (See section 7.1 for instruction on "PTO Type" programming – available in MY2009, BCM will no longer require programming)	PRESET – VARIABLE – MOBILE	MOBILE	For slow vehicle speed, high RPM operation, operate vehicle with transmission shift lever in "M" (manual mode) in drive range 1 or 2.
PTO In-Cab Control	DISABLED ENABLED	ENABLED	In-Cab Controls are automatically ENABLED in Mobile Variable PTO Mode
PTO Remote Control	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Type of Set Switch Operation	MOMENTARY LATCHING	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Press "ON" then go to Preset 1 Speed	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Remote Engine Start	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Remote Engine Shutdown	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Load feedback	DISABLED ENABLED	ENABLED	Optional feature, set to DISABLED if system does not provide PTO Load Feedback
Engage Relay	DISABLED ENABLED	ENABLED	The use of the PTO Load Engagement Relay is recommended for safety reasons. The feature is optional, set to DISABLED if system does not use a PTO Load Engagement Relay. Following circuit design provided above when used to avoid setting PTO Diagnostic Trouble Codes (DTCs). 'Engage Relay' is DISABLED in factory programming and must be ENABLED with the Tech 2 if a load engagement relay is to be used.
Keep Relay engage during braking	DISABLED ENABLED	ENABLED	After PTO is engaged, by setting this feature to ENABLED, the PTO Engagement Relay will remain enabled while the brake is pressed. The PTO "OFF" must be pressed to disable PTO.
Action after brake is released	RETURN TO BASE IDLE RPM – RETURN TO STANDBY RPM	RETURN TO STANDBY RPM	Setting this feature to "RETURN TO STANDBY RPM" will result in the following PTO operation: After PTO has been disabled by pushing the brake, once the brake is released, engine RPM will automatically return to standby speed and re-enabling the PTO Load Engagement Relay. Setting this feature to "RETURN TO BASE IDLE RPM" will result in the following PTO operation: After PTO has been disabled by pushing the brake and the brake is released, PTO will remain disengaged (engine RPM will remain at BASE IDLE speed and the PTO Engagement Relay will remain "OFF" (disabled).
Auto Engine Shutdown Timer	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Engine Shutdown due to Critical Engine Condition	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Engine Shutdown warning	DISABLED ENABLED	N/A	Feature is automatically disabled in Mobile Variable PTO Mode
Note: See beginning of Section 10 for engine speed parameters. The user can re-program these parameters to meet the specific requirements of the PTO application.			

11. APPENDIX C: PTO Module Harness Connector

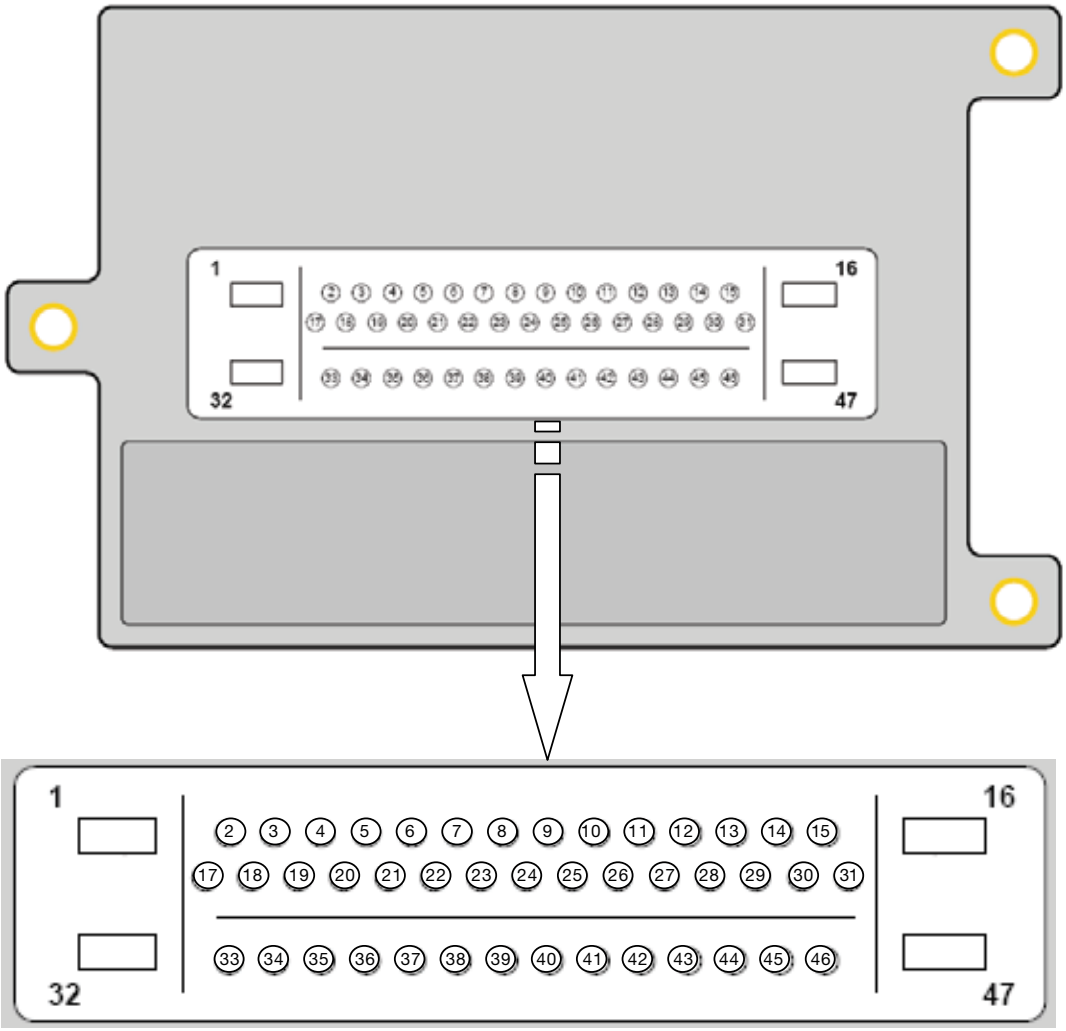


Table 9

(continued on Page 42)

11. APPENDIX C: PTO Module Harness Connector (cont'd)

Table 9

Cavity	Ckt #	Wire Color	Circuit Description
1	451	BK/WH	Power Ground
2	970	YE	INCAB Mode Reference
3	– – –	– – –	not used
4	– – –	– – –	not used
5	– – –	– – –	not used
6	2501	n/a	GMLAN-B (-)
7	2500	n/a	GMLAN-B (+)
8	974	PU	INCAB Mode Return
9	– – –	– – –	not used
10	977	L-BU	Remote Accelerator
11	972	D-GN/WH	INCAB Mode Select B
12	973	TN	INCAB Mode Select C
13	6085	BN/WH	Remote Engine Start
14	981	TN	Remote Tach / Remote PTO Lamp
15	979	D-BU	Remote PTO Arming
16	– – –	– – –	not used
17	5986	L-BU	Serial Data Communication Enable
18	– – –	– – –	not used
19	– – –	– – –	not used
20	– – –	– – –	not used
21	2501	n/a	GMLAN-A (-)
22	2500	n/a	GMLAN-A (+)
23	976	GY/BK	Remote Mode Return
24	– – –	– – –	not used
25	– – –	– – –	not used

(continued on Page 43)

11. APPENDIX C: PTO Module Harness Connector (cont'd)

Table 9 (cont'd)

Cavity	Ckt #	Wire Color	Circuit Description
26	971	BN	INCAB Mode Select A
27	6089	D-BU/WH	Remote Mode Set
28	2562	PU	PTO Engage Relay Low
29	6086	GY/BK	PTO LED Indicator
30	– – –	– – –	not used
31	494	L-BU	Remote Engine Shutdown
32	4540	RD/WH	Battery
33	6142	D-GN/WH	Engine Shutdown Control
34	975	WH	Remote Mode Reference
35	– – –	– – –	not used
36	– – –	– – –	not used
37	6311	???	Brake Pedal Apply
38	– – –	– – –	not used
39	– – –	– – –	not used
40	– – –	– – –	not used
41	– – –	– – –	not used
42	– – –	– – –	not used
43	– – –	– – –	not used
44	– – –	– – –	not used
45	978	GY	Remote Mode Enable
46	2522	YE	Load Feedback
47	6381	BN	PTO Engage Relay Hi

12. APPENDIX D: Service Diagnostics

12.1. Diagnostic Trouble Codes

The following table lists the diagnostic trouble codes (DTC) which can be set by the PTO Module:

Table 10

DIAGNOSTIC TROUBLE CODES	
Code Number	**Description**
P061C.00	Control Module Engine Speed Performance
P0641C.00	5 Volt Reference Circuit
P0703.00	Brake Switch Circuit 2
P159C.00	Power Take-off (PTO) Remote Engine Shutdown Switch Circuit
P251A.00	Power Take-off (PTO) Enable Switch Circuit
P251E.00	Power Take-off (PTO) Engine Shutdown Control Circuit Low Voltage
P258E.00	Power Take-off (PTO) Enable Switch Performance
P260B.00	Power Take-off (PTO) Relay Control Circuit Low Voltage
P260C.00	Power Take-off (PTO) Relay Control Circuit High Voltage
C0550.32	Electronic Control Unit Performance (General Memory Failure)
	1. Control Module Long Term Memory Reset
	2. Control Module Long Term Memory Performance
C0550.34	Electronic Control Unit Performance (RAM)
C0550.35	Electronic Control Unit Performance (ROM)
C0550.39	Electronic Control Unit Performance (Internal Electronic Failure)
C0550.48	Electronic Control Unit Performance (Cal. Data Not Programmed/Learned)
C0899.03	Device Voltage Low
C0900.07	Device Voltage High
U0100.00	Lost Communication with ECM
U0101.00	Lost Communication with TCM
U0140.00	Lost Communication with BCM